METHODOLOGICAL FRAMEWORK FOR ASSESSMENT AND MAPPING OF ECOSYSTEM CONDITION AND ECOSYSTEM SERVICES IN BULGARIA

PART B8

METHODOLOGY

for assessment and mapping of FRESHWATER ecosystems condition and their services in Bulgaria

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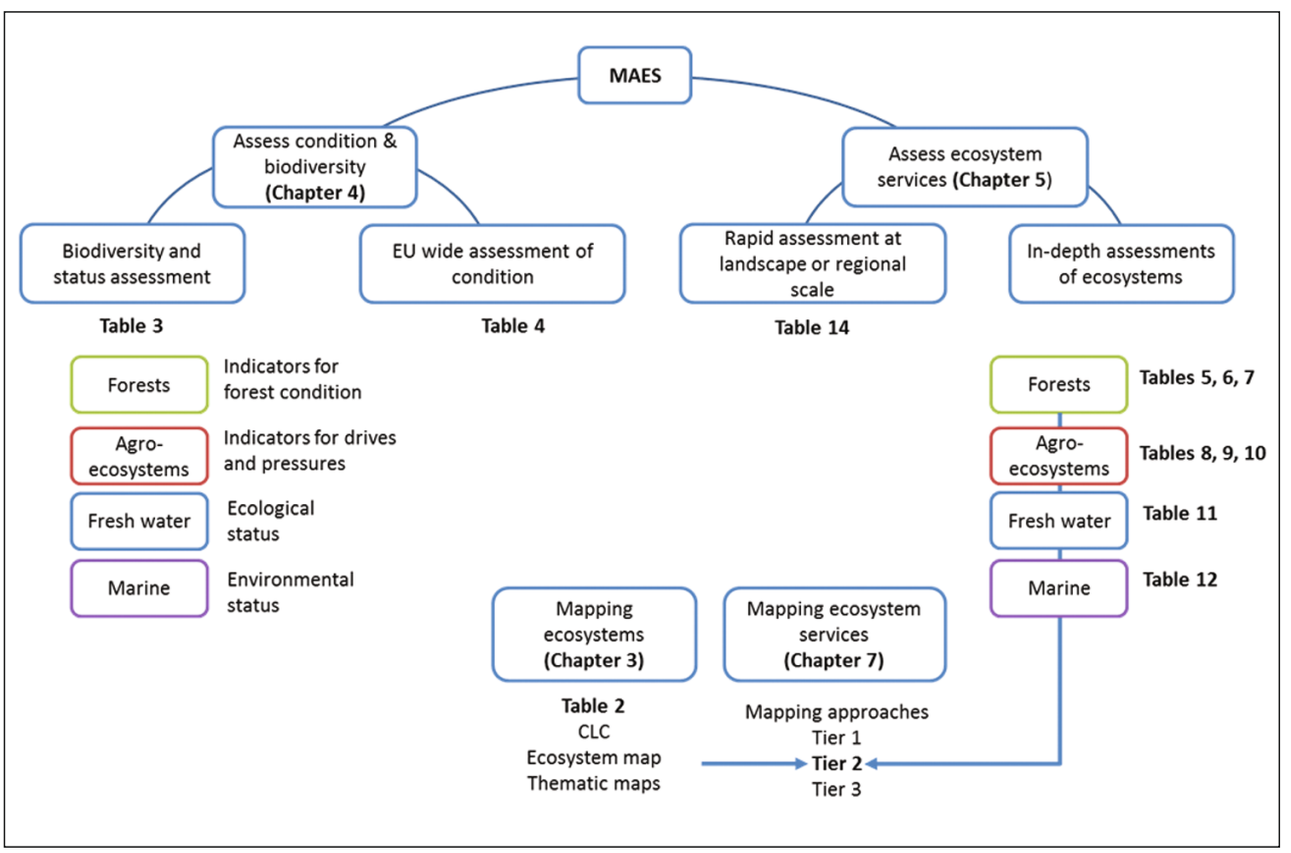
1. Introduction

This document represents the methodology for assessment and mapping of the FRESHWATER ecosystems and their servoces provided from water bodies in Bulgaria. The methodology follows the conceptual model and general layout of the MAES 2nd Working paper (2013) as it shown below:



1.1. What is this methodology about?

The current methodology is part of the national methodological framework for mapping and assessment of ecosystem services which aims at streamlining the national ecosystems and ecosystem services mapping and biophysical assessment process in Bulgaria. The methodology is not aimed at completing the full cycle of ecosystem service valuation and reporting[1]. It delivers a practical step-by-step guidance for:

1. Assessment of the condition of the freshwater ecosystems.
2. Assessment of the freshwater ecosystems' potential to deliver ecosystem services (biophysical valuation).

[1] Mapping and Assessment of Ecosystems and their Services An analytical framework for ecosystem assessments under Action 5 of the EU Biodiversity Strategy to 2020. Discussion paper , 2013

The methodology is relevant to freshwater ecosystems on the entire territory of Bulgaria although its implementation will differ between NATURA 2000 zones and areas outside NATURA 2000 due to different data availability, land use and the spatial distribution of ecosystems. It will form a part of a wider national methodological framework (under development) which details the theoretical background behind the ecosystems approach applied in Bulgaria, as well as the necessary steps to undertake towards fulfilling Action 5 of Target 2 Maintain and restore ecosystems and their services of the EU Biodiversity strategy to 2020[2].

1.2. Who is this methodology for?

This methodology is to be used by:

Organizations and scientists that perform ecosystems status assessment and biophysical valuation of ecosystem services. Such organizations are expected to involve the beneficiaries/partners in the programs that have provided funding for the national process of ecosystems mapping and assessment – for NATURA 2000, the Operational Programme Environment 2014-2020 and outside NATURA 2000 – programme BG03 Biodiversity and ecosystem services 2009-2014

National and local authorities that wish:

- to provide the data they are producing to the Bulgarian biodiversity information system;
- to contribute to the national assessment results with their past or ongoing projects targeting ecosystem biophysical valuation and ecosystem services assessment on a regional or local scale;to plan future projects that will complement the national assessment and valuation.

Data users wishing to understand the contents and methods of data collection, including, but not limited to, organizations involved in environmental reporting, regional and local authorities, environmentally responsible companies, NGOs, and other stakeholders.

1.3. How to use this methodology?

The common methodological framework provides a combination of information on relevant data/ information sources that may be of interest to a wider circle of stakeholders, while the current methodology is dedicated to specific guidance for assessing ecosystem condition and ecosystem services (including data collection and verification, and mapping guidance).

The wider introductory parts are more likely to be of interest to policymakers and the general public. The more targeted use defined in the current methodology will be mostly needed by professionals involved in the national mapping and assessment exercise.

As the current methodology is a living document, comments are welcome in order to shape it as a national, widely reviewed and adopted guidance document.

[2] The **EU Biodiversity Strategy to 2020,** www.ec.europa.eu/environment

2. Typology of freshwater ecosystems in Bulgaria

The proposed typology of freshwater ecosystems (at level 2) corresponds with the ecosystem classification of MAES (2013), a combination of CORINE Land Cover (CLC) classes and the European Nature Information System (EUNIS) habitat classification types. In general, the typology of freshwater ecosystems contains only two sub-classes at level 2: **rivers** (lotic ecosystems) and **lakes** (lentic ecosystems), incl. coastal lakes without permanent connection to the sea (Table 1). The main difference between these two sub-classes is the presence/absence of a permanent water flow/current. Another source for classification is the provisions of the WFD which describes 4 categories of surface waters: rivers, lakes, transitional/brackish and coastal marine waters, besides artificial and heavily modified (human-made) ones. Large part of them are known also as wetlands together with some inland/terrestrial surface water bodies such as marshes, peat bogs, pools, etc. A separate group of inland surface water bodies are transitional water ecosystems whos biodiversity depends on changeable water salinity, especially in river estuaries, lagoons, and/or firths which might have no permanent connection to the coastal sea.

The reason to accept also the WFD typology evolves from the definitions of ecological status (WFD, Art. 2, namely item 21: "Ecological status" is an ***expression of the quality of the structure and functioning of aquatic ecosystems associated with surface waters***, classified in accordance with Annex V"). However, it is not advisable to eliminate artificial (man-made) and heavily modified water bodies such as reservoirs, especially smaller and smallest ones (numerous already abandoned and tending to semi-natural conditions), fish-ponds, aquaculture basins, etc, as far as they all are or could be important for wild-live protection/conservation and maintenance (excellent example is the cooling water reservoir Ovcharitsa, and many other).
Therefore we accept the EUNIS typology for (inland surface) freshwater ecosystems at the first three levels (see Table 1) and, where appropriate, conjoin it with the rivers' and lakes' typology after the WFD and the national legislation for characterization of water bodies (Ordinance No H-4/2013 as amended in 2014). This will allow us to use the available information about species diversity and ecological status of large number of water bodies of these categories in Bulgaria.
There are also several types and sub-types of water bodies, addressed by the WFD as "artificial" or "heavily modified" (WFD 2000/60/EEC, Art.2, Annex II) which could be classified as "Urban ecosystem" (see class **J** *Constructed, industrial and other* ***artificial habitats*** and BG Ecosystem type 109 - *Highly artificial man made waters and associated structures,* level 3). In general, the last ones are Inland artificial water bodies with wholly-constructed beds or heavily contaminated water, and their associated conduits and containers. They include highly artificial saline/brackish and non-saline waters with artificially constructed beds or heavily contaminated water bodies (such as salt-works and/or industrial lagoons) which are virtually devoid of plant and animal life. Also they could be salt works by the sea coast, but excludes man-made but semi-natural water bodies (compare with C1, C2, and C3). And further at level 3, there are several subtypes (J5.1-J5.5) – all of them man-made ones.

Table 1. Typology of freshwater ecosystems in Bulgaria

Level 1 (Major ecosystem category)	**Level 2** (Sub-classes)	**Level 3** (Ecosystem types)
(INLAND SURFACE) FRESHWATER	**C1. LAKES** (Lakes, ponds and pools of natural origin containing freshwater (i.e. nonsaline, brackish or salt water). Manmade freshwater bodies, including artificially created lakes, reservoirs and canals, provided that they contain seminatural aquatic communities)	C1.1. Permanent oligotrophic lakes, ponds and pools C1.2. Permanent mesotrophic lakes, ponds and pools C1.3. Permanent eutrophic lakes, ponds and pools C1.5. Permanent inland saline and brackish lakes, ponds and pools C1.6. Temporary lakes, ponds and pools
	C2. RIVERS (Running waters, including springs, streams and temporary water courses)	C2.1. Springs, spring brooks and geysers C2.2. Permanent non-tidal, fast, turbulent watercourses C2.3. Permanent non-tidal, smooth-flowing watercourses C2.5. Temporary running waters
	X01.ESTUARIES (Downstream part of a river valley, subject to the tide and extending from the limit of brackish waters. River estuaries are coastal inlets where there is generally a substantial freshwater influence).	The mixing of freshwater and sea water and the reduced current flows in the shelter of the estuary lead to deposition of fine sediments. Littoral and sublittoral habitat types typical of estuaries are included in A2 and A5, although many other habitat types including tidal rivers may occur in estuaries. **Includes Transitional waters as defined by the WFD**.
	X03. BRACKISH COASTAL LAGOONS (Expanses of shallow coastal salt water, of varying salinity and water volume, wholly or partially separated from the sea by sand banks or shingle, or, less frequently, by rocks)	Characterised by well-developed reedbeds and luxuriant submerged vegetation and having several morphological and botanical development stages in the process whereby sea becomes land. Fully saline coastal lagoons are classified as X02.
TERRESTRIAL	**J5.** Highly artificial **MAN-MADE WATERS** and associated structures. Constructed, industrial and other artificial habitats*	J5.2. Highly artificial saline and brackish running waters J5.3. Highly artificial non-saline standing waters J5.4. Highly artificial non-saline running waters

* Could be accepted as artificial and/or heavily modified water bodies, according to WFD 2000/60/EC, Annex V, Art. 2, it. 8 and 9.

2.1. Detailed ecosystem typology of freshwater ecosystems in Bulgaria

A selection of EUNIS classification on level 2 is proposed for detailed typology at level 3 for target ecosystem types. Descriptions of the detailed ecosystem sub-types at level 3 and their relations to other classification systems are provided in Table 2. Furthermore, the respective ecosystem types from the Bulgarian classification of rivers and lakesand the EUNIS habitats/ecosystems description and nomenclature are also provided in the table.

Table 2. Freshwater ecosystems typology (Level 3)

Valid EUNIS Codes for BG	Subtype	Description	EUNIS Nomen-clature	BG Water body types*
C	**Inland surface waters**	Inland surface waters are non-coastal above-ground open fresh or brackish waterbodies (e.g. rivers, streams, lakes and pools, springs), including their littoral zones. Includes constructed inland freshwater, brackish or saline waterbodies (such as canals, ponds, etc) which support a semi-natural community of both plants and animals; seasonal waterbodies which may dry out for part of the year (temporary or intermittent rivers and lakes and their littoral zones). Freshwater littoral zones include those parts of banks or shores that are sufficiently frequently inundated to prevent the formation of closed terrestrial vegetation. Excludes permanent snow and ice. Note that habitats that intimately combine waterlogged mires and vegetation rafts with pools of open water are considered as complexes.		
C1.	**Surface standing waters**	Lakes, ponds and pools of natural origin containing fresh (i.e. nonsaline), brackish or salt water. Manmade freshwater bodies, including artificially created lakes, reservoirs and canals, provided that they co ntain seminatural aquatic communities.	A2.1 – A2.8	**LAKES (**lentic ecosystems or stagnant water bodies**)**
C1.1	Permanent oligotrophic lakes, ponds and pools	Waterbodies with a low nutrient (nitrogen and phosphorus) content, mostly acid (pH 4-6). Includes oligotrophic waters of medium or high pH, e.g. calcareous and basic unpolluted nutrient-poor lakes and pools, which are rare in much of Europe and noted as a habitat of charophytes (C1.14). Excludes peaty, dystrophic waters (C1.4). Because of the low nutrient status, beds of vascular plants, including [*Callitriche*] spp., [*Potamogeton*] spp. and isoetids [Isoeto-Nanojuncetea] are often sparse and open.	A3.1 – A3.7	**L1, L2, L3, L11, L12, L13**
C1.2	Permanent mesotrophic lakes, ponds and pools	Lakes and pools with waters fairly rich in nutrients (nitrogen and phosphorus) and dissolved bases (pH often 6-7). Communities e.g. of *Littorelletea uniflorae* and Isoeto-Nanojuncetea. Many unpolluted lowland lakes and ponds are naturally mesotrophic, and support dense beds of macrophytes, which are absent in polluted waters. Beds of charophytes can occur in mesotrophic (C1.25) as well as in oligotrophic (C1.14) waters.	A4.1 – A4.7	**L4, L6, L8, L15, L16, L17**
C1.3	Permanent eutrophic lakes, ponds and pools	Lakes and pools with mostly dirty grey to blue-green, more or less turbid, waters, particularly rich in nutrients (nitrogen and phosphorus) and dissolved bases (pH usually > 7). Moderately eutrophic waters can support dense beds of macrophytes, but these disappear when pollution causes nutrient levels to rise further.	A5.1 – A5.7	**L6, L7**
C1.5	Permanent inland saline and brackish lakes, ponds and pools	Non-coastal brackish, saline or hypersaline lakes, ponds or pools and their pelagic vertebrates and plankton.	A7.1 – A7.9, A.7A	**L8, L9, L10,**
C1.6	Temporary lakes, ponds and pools	Freshwater lakes, ponds, pools, or parts of such freshwater bodies that become periodically dry, with their associated animal and algal pelagic and benthic communities. Habitats of the dry phase are listed under C3.5, C3.6 and 3.7.	B3.1 – B3.4	**L5**
C2	**Surface running waters**	Running waters, including springs, streams and temporary water courses.		**RIVERS** (lotic ecosystems or water flows/courses)

Valid EUNIS Codes for BG	Subtype	Description	EUNIS Nomen-clature	BG Water body types*
C2.1	Springs, spring brooks and geysers	Springs and resurgences, together with animal and plant communities dependent on the peculiar microclimatic and hydrological situation created by them. Excludes vegetated spring mires (D2.2, D4.1), where springs emerge through a (usually small) expanse of vegetation with little or no open water.		**R1**
C2.2	Permanent non-tidal, fast, turbulent watercourses	Permanent water courses with fast-flowing turbulent water and their associated animal and microscopic algal pelagic and benthic communities. Rivers, streams, brooks, rivulets, rills, torrents, waterfalls, cascades and rapids are included. The bed is typically composed of rocks, stones or gravel with only occasional sandy and silty patches. Features of the river bed, uncovered by low water or permanently emerging, such as gravel or rock islands and bars are treated as the littoral zone (C3). Includes high, mid and low-altitude, usually small to medium-sized streams as defined by the WFD 2000/60/EPC.		**R2, R3, R8,**
C2.3	Permanent non-tidal, smooth-flowing watercourses	Permanent water courses with non-turbulent water and their associated animal and microscopic algal pelagic and benthic communities. Slow-flowing rivers, streams, brooks, rivulets and rills; also fast-flowing rivers with laminar flow. The bed is typically composed of sand or mud. Features of the river bed, uncovered by low water or permanently emerging, such as sand or mud islands and bars are treated as the littoral zone (C3). Includes mid and low-altitude streams as defined by the WFD 2000/60/EPC		**R4, R5, R6, R7, R10, R11, R12, R13**
C2.5	Temporary running waters	Watercourses that cease to flow for part of the year, leaving a dry bed or pools. Habitats of the dry phase are treated under C3.5, C3.6 and C3.7. Vegetation communities may be of [*Paspalo-Agrostidion*], [*Parvopotamion*] or [*Sparganio-Glycerion fluitantis*].		**R9, R14, R15**
J5.2	Highly artificial saline and brackish running waters	Highly artificial inland saline or brackish waterbodies with perceptible flow.		**
J5.3	Highly artificial non-saline standing waters	Artificial watercourses and basins, together with their associated containers, holding freshwater with no perceptible flow. Includes ponds and lakes with completely man-made substrate, water storage tanks, intensively managed fish ponds, and standing waterbodies of extractive industries.		**
J5.4	Highly artificial non-saline running waters	Artificial watercourses and basins, together with their associated containers, carrying freshwater with perceptible flow. Includes sewers, running discharges from extractive industrial sites, subterranean artificial watercourses, and channels with completely man-made substrate. Excludes fountains and cascades.		**
X01.	**Estuaries**	Downstream part of a river valley, extending from the limit of brackish waters. River estuaries are coastal inlets where there is generally a substantial freshwater influence. The mixing of freshwater and sea water and the reduced current flows in the shelter of the estuary lead to deposition of fine sediments, often forming extensive intertidal sand and mud flats. In addition to herbs, they can also be colonised by shrubs creating thickets (e.g. Tamarix] spp.). Where the tidal currents are faster than flood tides, most sediments deposit to form a delta at the mouth of the estuary. Littoral and sublittoral habitat types typical of estuaries are included in A2 and A5, although many other habitat types including tidal rivers may occur in estuaries. Includes Transitional waters as defined by the WFD.	EUNIS – X01	**R16**
X03.	**Brackish coastal lagoons**	Lagoons are expanses of shallow coastal salt water, of varying salinity and water volume, wholly or partially separated from the sea by sand banks or shingle, or, less frequently, by rocks. Fully saline coastal lagoons are classified as X02. Characterised by well-developed reedbeds and luxuriant submerged vegetation.	EUNIS – X03	**L8, L9, L10,**

** According to the Ordinance H-4/2013 and later amendments (State Gazette No 79/2014). some of the types might be analogous but they are placed in two different eco-regions according to the WFD 2000/60/EEC, Annex XIA.*

*** Generally these are artificial and/or heavily modified water bodies, according to the WFD, Art.2 items 8 and 9. For artificial and heavily modified surface water bodies the differentiation shall be undertaken in accordance with the descriptors for whichever of the surface water categories most closely resembles the heavily modified or artificial water body concerned (WFD, Annex V.1.1 .v and 2.5).*

3. Data availability

This section is representing the main sources of data/info needed for mapping and assessment of the freshwater ecosystems. Also some real or potential gaps into, which might create problems in the process, are further discussed.

Significant amount of data about various parameters that provide information about the water ecosystems' ecological state have been developed in recent decades and years, mostly alongside implementation of the provisions of the Water Framework Directive 2000/60/EEC (WFD) and the Directive on Floods Risk Assessment and Management 2007/60/EEC (FRAM). Due to the well developed system for ecological status assessment in Bulgaria, a lot of information/data have been already collected and could be very useful for fulfiling the project's objectives. Specialised works/studies have been carried out while intercalibrating the rivers/lakes typology and referent conditions of the Bulgarian water bodies, incl. of some modified and/or artificial ones such as water accumulations/reservoirs. All these required wide range observations and monitoring of the main Biological Quality Elements (such as phytoplankton and/or phytobenthos, vascular plants/macrophytes, fish and bottom macroinvertebrates). Some of the information, especially developed during preparations and implementation of the second River Basins' Management Plans 2016-2021 and later – of the preliminary evaluations of the flood risk and Flood Risk Management Plans (adopted in late 2016) could be very helpful for this exercise while they contain a lot of data in digital form, partly spatial (geo-referred), and mostly qualitative and/or quantitative (Table 3).

All collected information should be available in data-bases/records of the EEA, RBDs (see Annex 1 for abbreviations used into the text) and of their clients/developers from academic institutes, universities, NGOs and commercial companies. In parallel, the establishment of the National Ecological Network NATURA'2000 and the monitoring of the biodiversity, incl. of water bodies, provided much data about aquatic species and habitats of special/conservation interest and importance. All this information could be available in EEA Biodiversity data-bases, RIEW and both National and Natural Parks and other protected territories/areas with own administration.

Most of the data collected untill now is applicable mostly for water quality analysis (mostly nutrients, specific [pollutants and priodity substances) and ecological status evaluation, and thus – for ecosystems' condition assessment. The availability of data about many structural and functional aspects of the water ecosystem functioning is still poor. Therefore the evaluation of the ecosystems services will be very preliminary until appropriate methods are developed and validated *in-situ*.

In accordance with the Ordinance H-4/2013 as amended in 2014 (State Gazette No 79/23.09.2014) the RBDs have to develop a GIS map or maps of the location and borders of the surface water bodies within each of the River Basins (Art. 3(1)). In general, besides national data producers (MOEW, RBDs, RIEWs, protected areas administration, municipal databases, etc.), a usefull and very supportive source of information, incl. structured and/or geo-referred data, are the available EU data sources (i.e. http://www.eionet.eu.int/gis; , CORINE LAND COVER, etc.).

Note that the ecosystem types in the European Map of Ecosystem types are defined as based on EUNIS classification. Hence, not all of the level 3 types determined for Bulgaria will correspond to the European ones. In this case, similar codes and classes are used, which are closer to these of the EUNIS classes.

Table 3. Sources of spatial and quantitative/qualitative data on freshwater ecosystems.

		DATABASE Sources – main stakeholders	
	Subtype Level 2	**Spatial**	**Quantitative/Qualitative**
C1.	**LAKES** (Surface standing waters)	Database EUNIS Level 2 (VV);NATURA-2000 mapping; National Concept for Spatial Development 2013-2025; Rivers Basins Management Plans 2009-2015 and next issue (2016-2021) Preliminary Flood Risk Assessments (MOEW/RBDs) Floods Risk management Plans (MOEW/RBDs)	National Monitoring of Biodiversity + NATURA 2000; Action Plans for Programs of Environmental protection; National Concept for Spatial Development 2013-2025, National Statistical Institute, Monitoring reports and data bases (MOEW/EEA/RBDs/ RIEW, MRD, EAFA), Publications, Reports of Research Projects.
C2.	**RIVERS** (Water courses)	Database EUNIS Level 2 (VV), NATURA-2000 mapping, National Concept for Spatial Development 2013-2025 Rivers Basins Management Plans 2009-2015 and next issue (2016-2021) Preliminary Flood Risk Assessments (MOEW/RBDs) Floods Risk management Plans (MOEW/RBDs)	National Monitoring of Biodiversity + NATURA 2000; Action Plans for Programs of Environmental protection, National Concept for Spatial Development 2013-2025, National Statistical Institute, Water Monitoring reports and data bases (MOEW/EEA/RBDs/ RIEW, MRD, EAFA), Publications, Reports of Research Projects.
X01	**Estuaries**	Database EUNIS Level 2 (VV), NATURA-2000 mapping, National Concept for Spatial Development 2013-2025 Rivers Basins Management Plans 2009-2015 and next issue (2016-2021) Preliminary Flood Risk Assessments (MOEW/RBDs)	National Monitoring of Biodiversity + NATURA 2000; NATURA-2000 mapping, National Concept for Spatial Development 2013-2025 Rivers Basins Management Plans 2009-2015 and next issues Preliminary Flood Risk Assessments
.	.	Floods Risk management Plans) (MOEW/RBDs)	(MOEW/RBDs) Floods Risk management Plans) (MOEW/RBDs)

		DATABASE Sources – main stakeholders	
	Subtype Level 2	**Spatial**	**Quantitative/Qualitative**
X03	**Brackish Coastal Lagoons**	Database EUNIS Level 2 (VV), NATURA-2000 mapping, National Concept for Spatial Development 2013-2025 Rivers Basins Management Plans 2009-2015 and next issue (2016-2021) Preliminary Flood Risk Assessments (MOEW/RBDs) Floods Risk Management Plans () (MOEW/RBDs)	National Monitoring of Biodiversity + NATURA 2000; River Basins Management Plans; Flood Risk Management Plans, Action Plans for Programs of Environmental protection, National Concept for Spatial Development 2013-2025, National Statistical Institute, Monitoring reports and data bases (MOEW/EEA/BSBD/ RIOEW, MRD, EAFA), Publications, Reports of Research Projects.

4. Mapping ecosystem types

The following section describes the procedure of mapping the ecosystem types, specifications of the final products for the maps and databases, and gives references to the Annexes to this document where database shema is provided in accordance to the specifications given hereafter.

4.1. Description of the mapping procedure

The workflow for mapping of ecosystem types comprises the following main steps:

- Generation of vector dataset with representation of polygon, polyline, or point features each of them containing information on level 3 ecosystem type;
- The source data needed to generate the vector datasets or the mapping approach should allow the specifications for the output scale, MMU and MMW to be kept as described in section 4.4.;
- Assembling the product in the geodatabase schema provided in the Annex 9 (Annex 9.00_EcosystemDatabase_Schema);
- Validation of the product accuracy, described in point 4.6. of this methodology;
- Preparation of digital maps of ecosystem types;
- Generation of metadata.

The specifications of the final product should follow the requirements provided in the following sections. As the outcome of each mapping project will be used for preparation of national dataset for ecosystem types at level 3, it is mandatory to follow each requirement described below.

4.2. Data format

Output data have to be delivered in GIS compatible vector format, in accordance with geospatial standards of OGC and INSPIRE.

The vector format should be with the following topology:

- In case all the ecosystems are presented as one geometry type - complete coverage in a single layer –;
- In case the different ecosystem types are represented with different geometry types, up to 3 layers could be delivered – one for polygon, one for polyline and one for point features.
- The vector layer has to be delivered in topologically correct geometries: see rules in - http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/An_overview_of_topology_in_ArcGIS/006200000001000000/.

4.3. Geographic projection / Reference system

Vector layer should be delivered in ETRS89-LAEA. The description and definition of ETRS89 is based on the convention of ISO19111, the 'Spatial referencing by coordinates' standard. For further documentation on ETRS89, see:

http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_RS_v3.2.pdf, and;

http://www.eionet.eu.int/gis

4.4. Geometric resolution – scale and minimum mapping units

The source data which will be used for the ecosystem type mapping vary in geometric resolution, as well as in the level of detail of the different ecosystem types. Hence, the output vector dataset containing the graphical representation of the ecosystem types should be delivered in scale between 1:10 000 and 1:25 000, depending on:

– the used source data;

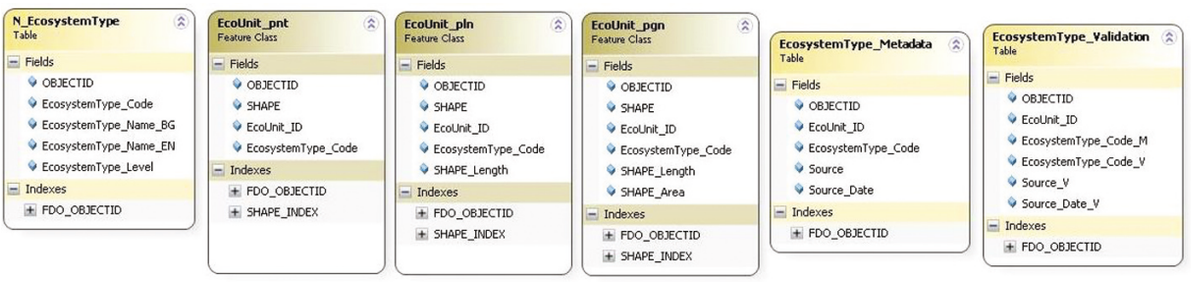
– the ecosystem type on level 3.

The minimum mapping area should be between 0.1 and 0.25 ha also depending on the source data used and the mapped ecosystem type. The same apply for minimum mapping width of representing linear features: minimum 10 and up to 30 m.

4.5. Data structure/schema

The structure of the database should follow the one provided in the Annex 9.00 – both on number of vectors and tables delivered the structure of each feature class and tables, and nomenclatures provided in the same Annex. The database schema in Annex 9.00 is provided in XML and Personal DataBase format – OCG and INSPIRE compatible.

The schema of the database for the ecosystem types is presented inFigure 1.



Fifure 1. Ecosystem Types Database Schema

The detailed technical description of the classes and tables of the ecosystem types database is provided in Annex 9.01_Schema_Report_ES_Database in the file 9.01_1_Schema_Report_ES_Database.htm.

The following steps were undertaken for the creation of the geodatabase:

- Feature Class **"EcoUnit"** -this is the vector feature class which contains the information on ecosystem types at level 3. The attribute fields of the feature class which have to be filled are as follows:

- EcoUnit_ID: each object should have unique ID;EcosystemType_Code: this field should contain 3 digit value of the ecosystem type at level

- The value for the ecosystem code should be taken from the nomenclature table N_EcosystemType/EcosystemType_Code provided in Annex 9.02_NOMENCLATURES_XLS. This field is used for relating all the tables and feature classes in the database.

Since, the object geometry of the different ecosystem types could be point, polyline, or polygon, up to 3 feature classes **"EcoUnit"** could be generated and named as follows:

- **EcoUnit_pnt**: for objects with point geometry;

- **EcoUnit_pln**: for objects with polyline geometry;

- **EcoUnit_pgn**: for objects with polygon geometry.

- Table **"N_EcosystemType"**: Nomenclature table for ecosystem type levels at level 2 and 3. This table should not be changed. It has the following fields:

- EcosystemType_Code: integer codes for ecosystem types at level 2 and 3;

- EcosystemType_Name_BG: names in Bulgarian of ecosystem types at level 2 and 3;

- EcosystemType_Name_BG: names in English of ecosystem types at level 2 and 3;

- EcosystemType_Level: check field defining the level of each ecosystem type with values 2, for level 2 and 3 for level 3;

- Table **"EcosystemType_Metadata"**: Table providing information on datasources used when defining the ecosystem type for each feature from the Feature Class **"EcoUnit"**:

- EcoUnit_ID: field to relate with the feature class;

- EcosystemType_Code: integer codes for ecosystem types at level 3;

- Source: free description of the source used to map the specific ecosystem type for each feature;

- Source_Date: date of the source used to map the specific ecosystem type for each feature;

- Table **"EcosystemType_Validation"**: Table providing information on work performed to validate the thematic accuracy for the final product:

- EcoUnit_ID: field to relate with the feature class;

- EcosystemType_Code_M: integer codes for ecosystem types at level 3 of the final product;

- EcosystemType_Code_V: integer codes for ecosystem types at level 3 derived in the validation process;

- Source_V: free description of the source used to validate the ecosystem type;

- Source_Date_V: date of the source used in the validation.

4.6. Thematic accuracy and validation

The overall thematic accuracy for all ecosystem types should be >=85%.

The validation should be based on scientifically sound approach used for validation of the product thematic accuracy.

Apart from providing information in Table **"EcosystemType_Validation"**, the validation should be accompanied by Quality Control/Quality Check Reports for each ecosystem type.

4.7. Digital Maps for Ecosystem Types

Maps in scale 1:125 000 for the ecosystem types should be in PDF at size A2. In addition the maps could also be prepared in paper format in the same scale and size.

Each data frame should represent one cell from the EEA 50 km reference grid; hence up to 77 maps could be produced for all the cells of the 50 km EEA gird for Bulgaria. In case that no objects from Feature Class **"EcoUnit"** fall in certain cell, map for this cell should not be delivered. Therefore, the actual number of maps to be delivered will depend on the number of cells that contain at least one object from Feature "**Class EcoUnit**". The EEA reference grid is available at:

http://www.eea.europa.eu/data-and-maps/data/eea-reference-grids/

Color codes for visualization of the ecosystem types at level 3 should be in accordance to these used in the European Map of Ecosystem types:

http://biodiversity.europa.eu/maes/mapping-ecosystems/map-of-european-ecosystem-types

The technical details for the map, as well as color codes are accessible at:

http://projects.eionet.europa.eu/eea-ecosystem-assessments/library/draft-ecosystem-map-europe/

The ecosystem types in the European Map of Ecosystem types are defined based on EUNIS classification. Hence, not all of the level 3 types determined for Bulgaria will correspond to the European ones. In this case, similar color codes should be used, which are closer to these of EUNIS classes. When generating these color codes the guideline of EEA should be used, available here:

http://www.eionet.europa.eu/gis/docs/EEA%20Corporate%20identity%20manual%20Map%20colour%20guide.pdf

The layout of the maps of the ecosystem types should follow the guidelines of EEA:
http://www.eionet.europa.eu/gis/docs/GISguide_v4_EEA_Layout_for_map_production.pdf

4.8. Metadata

Each dataset should be accompanied by INSPIRE conformal metadata. The minimum requirement is the metadata to be generated using the INSPIRE MetadataEditor:

http://inspire-geoportal.ec.europa.eu/editor/

5. Assessment of freshwater ecosystem condition

5.1. Steps for assessment of freshwater ecosystem condition

Step 1 Identify the indicators of ecosystem *condition* for the given ecosystem type - *levels* 3/4

For the feasibility of the assessment procedure it is recommendable to select several common parameters (metrics) to serve as indicators for the assessment/evaluation of the ecosystems' status/ condition. Concerning inland surface freshwater bodies (lakes and rivers + several estuaries and coastal lagoons/ wetlands), these could be: pollutant concentrations (especially hazardous and dangerous substances, nutrients, heavy metals, etc., ref. regular monitoring data), hydro-morphological modifications (water intakes, damming/barraging, etc., ref. ECRINS) within the river

basin and/or downstream the river course, data on fish (over-) exploitation, etc. After the WFD, based on biological quality elements (BQEs) there is a relative score unit – Ecological Quality Ratio (EQR), which supports the assessment of ecological status of each water body. The application of such an approach requires the use of specific bio-indicator amongst species diversity of river or lake aquatic communities and lakes, which have been well developed in Bulgaria during the last decades. Collecting materials form phytoplankton or phytobenthos, macrophytes, bottom invertebrates and fish fauna allows also to check the findings for presence and/or share of invasive species, total or relative abundance of sensitive species and/or taxonomic groups, and also to check for presence of species of conservation value/importance (ref. SEBI 02 Red List for EU species).

The rationales for the selection of indicators to assess the ecosystem condition (status) are presented in Table 4 and follow the current national legislation on ecological status assessment of the water bodies (ref. Ordinance No H-4/2013, as amended in 2014).

Table 4. Rationales of ecosystem condition's indicators

Ecosystem condition Indicator group	**Indicators/Rationales**
Biotic diversity	Spatial or temporal variability of resources. Biotic diversity is caused by organisms. It may occur even in absence of abiotic heterogeneity. Positive relationships between plant species habitat heterogeneity and animal species diversity are well documented on different scales (Davidowitz & Rosenzweig, 1998), but empirical and theoretical studies have showed contradictory results (Tews et al., 2004). Effects of biotic heterogeneity may vary considerably depending on what is perceived as a habitat by the species group studied. Structural attributes of the vegetation that constitute habitat heterogeneity for one group may be perceived as habitat fragmentation by another taxonomic group (e.g. Okland, 1996).To determine biotic factors and freshwater habitat heterogeneity the following groups of indicators are proposed: *"Plant diversity" ,* *"Animal diversity",* *"Invasive species",* A possible indicator is: *"Other biotic heterogeneity indicators (naturalness etc.)"*
Abiotic heterogeneity	Spatial or temporal variability of abiotic resources and factors. Abiotic heterogeneity has abiotic origin, but it might be heavily modified by humans. To determine abiotic factors and abiotic heterogeneity the following groups of indicators are proposed: *"Hydrological heterogeneity"* *"Bottom sediments/granulometry"* *"Disturbance regime",* Possible indicators are: *"Geo-morphological heterogeneity",* *"Other abiotic heterogeneity indicators"*

Ecosystem condition Indicator group	Indicators/Rationales
Energy budget	Energy is the lifeblood of ecosystems and of the biosphere as a whole. At the most fundamental levels, what ecosystems do is capture and transforms energy. To account energy budget in freshwater ecosystems possible groups of indicators are: "*Energy balance (capture, storage)*", "*Entropy production*", "*Metabolic efficiency*", "*Other energy budget indicators*"
*Matter budget	Matter budget describes the cycle in which matter is transformed from one state to another within the components of freshwater ecosystems. To account matter budget in freshwater ecosystems the proposed groups of indicators are : *"Matter storage"* *"Alluvial regime/Suspended solids",* Other possible are: *"Matter balance (input, output)"* *"Element concentrations (other state variables)"* *"Efficiency measures"*
Water budget	The cyclical movement of water between the atmosphere and the ground surface in freshwaters areas, considering precipitation, evaporation, and runoff. The following indicator is proposed: *"Water balance (input, output)",* Other possible are: *"Water storage",* *"Other state indicators",* *"Efficiency measures"*

Step 2 Select condition indicators for freshwater ecosystems

Methods to provide national level indicators that take into account spatial diversity have to be assessed and developed based on spatial databases available at national and European level (CORINE, GMES) and for the purposes of facilitating international comparison. Condition (status) indicators assess environmental states (climatic, chemical, physical, biological state of habitat) in freshwater ecosystems. We have defined and quantified about 40 indicators that are relevant for the freshwater ecosystem conditions. The indicators represent the ecosystems structure and ecosystem processes of freshwater ecosystems types, corresponding with current national legislation (Ordinance No H-4/2013).

A set of indicators for the assessment of the freshwater ecosystems condition different parameters of evaluation are proposed, close to those used in routine monitoring of ecological status of water bodies. Some of the proposed indicators are relevant to the current inventories database (habitat area and distribution, elements concentration, depth/velocity/discharge, water temperature, pH, water transparency/turbidity, Chlorophyll A concentration, number of species, and species diversity, abundance (density, ratios) etc. Considering the number of proposed parameters, the number of parameter combinations and possible (optional, additional) indicators is very large, which ensures the representative assessment of freshwater ecosystems.

The selected condition/state indicators for freshwater ecosystems are presented in Annex 6 and Table 5 below.

Step 3 Data collection – national data sets *(see Annex 5*)

Given the broad spectrum of scientific disciplines that cover the concept of ecosystem services, a full assessment of the impact of drivers and pressures on the provision of ecosystem services requires an interdisciplinary data combining approach. It requires coupling large scale environmental data sets or even very complex models that simulate processes taking place in the atmosphere, watersheds, soils and freshwater ecosystems with models that simulate socio-economic and agricultural systems in close relation with the consequences of resource use on land dynamics. Such integrated assessment needs to be translated into suitable indicators for freshwater ecosystem functions and services and subsequently to the benefits obtained from these services.

Some of the mentioned data sources are highly relevant for establishing representative indicators (statistics, reports, remote-sensing, and EU and national database). Nevertheless other data sources (as additional measurements) must also be utilized for various national data bases, and/or from scientific publications.

The basic sources of data/information of the MOEW are: National Ecological Network NATURA '2000; National System for Monitoring of Biodiversity, National System for Water Monitoring, River Basins Management Plans (updated and actualized in late 2016) lies ahead in the current/next years), Floods Management Plans). Some databases within the premises of the Ministry of Regional Development (urban water and sanitation systems), Ministry of Agriculture & Food, incl. Forestry Agency, Agency for Fishery & Aquacultures and Irrigation Systems State Company, Ministry of Economics & Energetic with State Company Reservoirs & Cascades, National Institute of Statistics, many municipalities, etc.

Step 4 Assessment of freshwater ecosystem condition

The indicators of freshwater ecosystems condition can be assessed through scoring, as shown in Table 5. The range of each parameter for the different scores determines the ecosystem condition for each sub-type and is defined by the experts in the field, approved through professional experience and expertise. The example presented in Table 5 could be applied in performing the assessment of both ecosystem condition and ecosystem services supply. The ecosystem service projects using other indicators, which are defined for the current methodology.

In the case of freshwater ecosystems condition assessment there are well developed and workable procedures and indicators for almost all river or lake types in Bulgaria (see Ordinance No H-4/2013 as amended in 2014). Multiple both biological and chemical indicators and their respective metrics/ranges are listed for EQR determination according to the requirements of the WFD. This makes easier the assessment of the condition of the respective riverine or/and lake ecosystems because of the basic WFD statement that "ecological status" is accepted as an ***expression of the quality of the structure and functioning of aquatic ecosystems associated with surface waters*** (WFD, Art. 2, item 21). However the Directive requires also evaluation of chemical and hydro-morphological quality elements for the assessment of the capacity of an aquatic ecosystem to provide relevant potential of ecosystem goods and services.

Table 5. Ecosystem conditions indicator assessment for freshwater ecosystems

Ecological condition indicators		Indicator	Parameter	Units	Measurment approach*	Assesment scale and score				
Type	Indica-tor Group					Score 1	Score 2	Score 3	Score 4	Score 5
Ecosytem structure		Plant diversity (both phyto-plankton/ phytobenthos and macrophytes)	diatom index (IPS)	number	estimation	>17,5	>13,5	>9,5	>5,5	<5,5
				EQR	calculation	0,85<	0,64<	0,43<	0,22<	<0.22
			macrophytes referent index	number	estimation	100 - 3	2 - (-45)	(-46) - (- 69)	(-70) - (-100)	no macro phytes
				EQR	calculation	1,0-0,52	0,51–0,28	0,27– 0,16	0,15 – 0,00	n.a.
		Animal diversity (both of macro-invertebrates and fish)	number of protected species	number/ density	calculation					
			total/relative number of species	number/ ratio	calculation	16+	11-15	6-10	2-5	0-1
		Other biotic heterrogeity indicators (naturalness etc.)	trophic structure of the community	number/ ratio						
			adapted biotic index (ABI)	scores	estimation	4,5 -5	3,5 - 4	2,5 - 3	2,00	1,5 -1
				EQR	calculation	0,87-1,0	0,67-0,86	0,5-0,66	0,40	0,3-0,2
			fish-based index (for rivers)	number						
			trophic structure of the community	number/ ratio						

* In this table “estimation” means data obtained after a measurement or determination, while “calculation” means a processing of numbers/data obtained

The above listed indicators were chosen in order to serve for a comprehensive assessment of the condition of this ecosystem type. They must be used as described in the present methodology. At the same time, the team conducting the assessment may add and test, after using the above listed, other new indicators – which are being recently developed and under development on European and national level or based on the good practices and practical experience. The new indicators should be considered useful, adequate or more appropriate for the purpose to comprehensively assess the ecosystem condition by the involved experts. Such indicators must be used in the same methodological manner – by determining parameters, units, measurement and assessment scale from 1 to 5, and must be consistant with the MAES research activities, guidelines and reports on the EU scale. The new indicators must be described in the final reports of accomplished tasks and the benefits of their use in future assessment should be clearly described through comments and estimations regarding the usefulness and applicability of the indicators listed in this methodology

have to be made, on a basis of the experience acquired in their use.
Other convenient indicators to assess ecosystem condition are those reflecting naturalness, wilderness, status of representative species or species group and communities, high nature value areas, etc.
More information regarding the efforts at the EU level to determine the most adequate and appropriate indicators to the ecosystem condition can be obtained via the web-pages of the institutions and research centers involved[3], where publications such as "Developing conceptual framework for ecosystem mapping - part B Ecosystem condition mapping (draft)" and other relevant documents can be found.
The total score of each group of indicators is calculated as average of scores for the included indicators referred to the specific freshwater sub-type ecosystem. The final number should be presented as integer.

The values of calculated scores of both structural and functional indicators are representative for the condition of specific ecosystem type. The value obtained must be rounded to the nearest first decimal place, and for the purpose of mapping to an integer.

Step 5: Matrix of ecosystem condition

The final scores for each indicator should be filled in matrix of ecosystem condition (Table 6). The matrix presented in Table 6 is an example, which should be verified with *in-situ* measurements and data collection (see Guide for *in-situ* verification).

Table 6. Ecosystem condition indicator assessment template and calculation – example

Indicator type	Indicator group	Indicator	Parameter	Units	Measured data	Score N
Ecosytem structure	Biotic Heterogeneity	plant diversity phytoplankton/ phytobenthos and macrophytes	diatom index (IPS)	number	12,8	**3**
				EQR		
			macrophytes referent index	number	-18	**4**
				EQR		
		animal diversity (both of macro-invertebrates and fish)	number of protected species	number / density		
			total/relative number of species	number / ratio	14	**4**
		Other biotic heterrogeity indicators (naturalness, etc.)	trophic structure of community	number / ratio		
			adapted biotic index (ABI)	scores	4	**4**
			fish-based index	scores		
					(Σn_i)	**15**
					IP	**0,75 (75%)**

Explanation: for each indicator, according to its parameter' scoring, based on experts' assessments and further in-situ verification, are assigned values from 1 to 5, according to the scale: 1 – very bad; 2 – bad; 3 – moderate; 4 – good; 5 – very good. The scores of each indicator measured are then summed up (Σn_i).

[3] For example http://projects.eionet.europa.eu/eea-ecosystem-assessments/library and others.

An additional index of ecosystem performance (IP) is proposed for specific purposes in decision-making process. It is calculated as ratio of the sum of the indicators scores maximum possible indicator sum: IP = Σni/ Σni(max) , and belongs to the range (0 and 1).

Where:

Σni – the sum of the indicator's assessments.

Σni(max) – sum of the maximum of indicator assessment (i.e. nx5).

The IP assessment scores for the different condition of the ecosystems are as follows:

IP 0-0,20 – very bad; 0,21-0,40 – bad; 0,41-0,60 – moderate; 0,61-0,80 – good; 0,81-1,0 – very good.

In our case the ecosystem condition is 0,80 – good.

The IP index is not obligatory, but recommended if requested for fulfillment specific tasks in strategy development by different stakeholders.

5.2. Mapping of Ecosystem condition

The following section describes the procedure of mapping the ecosystem condition, specifications of the final products for the maps and databases, and gives references to the Annexes to this document where database shema is provided in accordance to the specifications given hereafter.

5.2.1. Description of the mapping procedure

The workflow for mapping of ecosystem condition follows the steps described in section 5.1. The technical characteristics of the geodatabase are provided in section 4 and should be applied also for mapping procedures in this section.

5.2.2. Ecosystem Condition Data structure/schema

The data structure should follow the one provided in the Annex 9.00.

The schema of the database for the ecosystem states is presented in Figure 2.

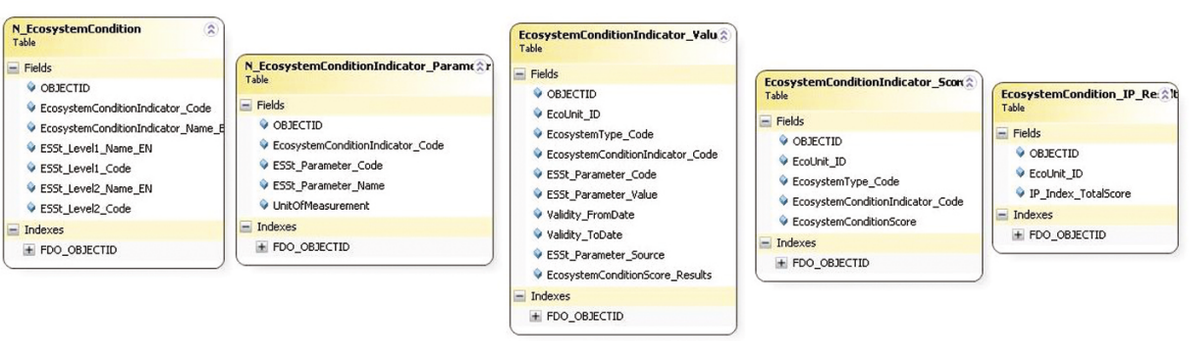


Figure 2. Ecosystem Condition Database Schema

The detailed technical description of the classes and tables of the ecosystem condition database is provided in Annex 9.01_Schema_Report_ES_Database in the file 9.01_1_Schema_Report_ES_Database.htm

The main steps of generation of the geodatabase should follow the steps described in section 5.1.:

- Table **"N_EcosystemCondition"**: Nomenclature table for ecosystem condition indicators. This table should not be changed. The nomenclatures are given in Annex 9.02_NOMENCLATURES_XLS / N_EcosystemCondition.xls. It has the following fields:

- EcosystemConditionIndicator_Code: integer codes for ecosystem condition indicators at level 3;

- EcosystemConditionIndicator_Name_EN: names in English of ecosystem condition indicators at level 3;

- ESSt_Level1_Name_EN: names in English of ecosystem condition indicators at level 1;

- ESSt_Level1_Code: integer code of ecosystem condition indicators at level 1;

- ESSt_Level2_Name_EN: names in English of ecosystem condition indicators at level 2;

- ESSt_Level2_Code: integer code of ecosystem state indicators at level 2;

- Table **"N_EcosystemConditionIndicator_Parameters"**: Nomenclature table of parameters used to determine the ecosystem condition indicator. The nomenclatures are given in Annex 9.02_NOMENCLATURES_XLS / N_EcosystemConditionIndicator_Parameter.xls. It has the following fields:

- EcosystemConditionIndicator_Code: integer codes for ecosystem state indicators at level 3;

- ESSt_Parameter_Code: integer codes for parameters used to assess the ecosystem indicators at level 3;

- ESSt_Parameter_Name: name of parameters used to assess the ecosystem indicators at level 3;

- UnitOfMeasurement: units of measurement for each parameter.

This nomenclature table should be generated using the example provided in Annex 9.02_NOMENCLATURES_XLS / N_EcosystemConditionIndicator_Parameter.xls, as well as the Table 5. *Ecosystem condition indicator assessment for XXX ecosystems*.

- Table **"EcosystemConditionIndicator_Values"**: This table is the resulting table from the assessment of the ecosystem indicators. How to perform the work on assessment of the indicators is described in Step 4 in section 5.1:

- EcoUnit_ID: field to relate with the feature class;

- EcosystemType_Code: integer codes for ecosystem types at level 3;

- EcosystemConditionIndicator_Code: integer codes for ecosystem condition indicators at level 3;

- ESSt_Parameter_Code: integer codes for parameters used to assess the ecosystem indicators at level 3;

- ESSt_Parameter_Value: value of calculated parameter used to assess the ecosystem indicators at level 3;

- Validity_FromDate: starting date for validity of the parameter;

- Validity_ToDate: end date for validity of the parameter;

- ESSt_Parameter_Source: free text to describe the source of the data used to calculate the value of the parameter;

- EcosystemConditionScore_Results: final score for each parameter calculated using the guidelines provided in Table 5. The values here should be between 1 and 5;

As this resulting table could contain enormous number of records which some GIS software could not support it is acceptable to separate it into smaller tables. In this case the records in the table should be separated based on the ecosystem types at level 3. The naming of the table should be done in the following way:

"EcosystemConditionIndicator_Values_XXX" – where XXX is the code of the ecosystem type at level 3.

- Table **"EcosystemConditionIndicator_Score"**: As for some indicator more than one parameter could be selected for measurement, additional table is required which represents the total score for each condition indicator calculated from the total score of parameters measured. Because some of the parameters could be more important than others, it is of responsibility of the expert to choose what will be the final score based on the values of the parameters calculated:

- EcoUnit_ID: field to relate with the feature class;

- EcosystemType_Code: integer codes for ecosystem types at level 3;

- EcosystemConditionIndicator_Code: integer codes for ecosystem condition indicators at level 3;

- EcosystemConditionScore: final score for each indicator calculated on the base of all parameters selected for its evaluation. The values here should be between 1 and 5;

In order the database to be more informative, one table for each condition indicator at level 3 should be prepared and named as follows: "**EcosystemConditionIndicator_Score_YYY"** where YYY is the code for condition indicators at level 3.

- Table **"EcosystemCondition_IP_Results"**: This table is the resulting table from the assessment of the ecosystem indicators and calculation of the IP for each ecosystem type at level 3. How to perform the work on assessment of the indicators is described in Step 4 in section 5.1:

- EcoUnit_ID: field to relate with the feature class;

- IP_Index_TotalScore: value for the index of ecosystem performance (IP) for each polygon representing ecosystem type at level 3. How to calculate the value is described in Step 4 in section 5.1 and an example is given in Table 7 *Ecosystem condition indicator assessment template and calculation – example*.

5.2.3. Accuracy and validation

The validation should be based on scientifically sound approach being able to assess the accuracy reached for each ecosystem condition parameter. For each validation accuracy reports should be generated and provided.

5.2.4. Digital Maps for Ecosystem Condition

Maps in scale 1:125 000 for the ecosystem condition should be delivered in PDF at size A2 presenting the results from calculation of the IP index. In addition the maps could also be prepared in paper format in the same size.

Each data frame should contain one cell from the EEA reference grid at 50km, hence up to 77 maps could be produced for all the cells from the 50km EEA gird for Bulgaria. In case that no objects from Feature Class **"EcoUnit"** fall in certain cell, map for this cell should not be delivered. Therefore, the actual number of maps to be delivered will depend on the number of cells that contain at least one object from Feature "Class **EcoUnit**". The EEA reference grid is available at:

http://www.eea.europa.eu/data-and-maps/data/eea-reference-grids/

For visualization of the IP index graduated colors should be used. Five classes should be generated as follows: 1 – very bad (values > 0 to 0.20); 2 - bad (values > 0.20 to 0.40); 3 – moderate (values > 0.40 to 0.60); 4 – good (values > 0.60 to 0.80); 5 – very good (values > 0.80 to 1).

The colour ramp should use for class 1 blue color (CMYK:50;100;5;30), class 2 violet color (CMYK:18;100;0;0), class 3 pink color (CMYK:0;70;40;0), class 4 orange color (CMYK:0;30;100;0), and for class 5 green color (CMYK:40;5;100;0).

The layout of the maps of the ecosystem types should follow the guidelines of EEA:

http://www.eionet.europa.eu/gis/docs/GISguide_v4_EEA_Layout_for_map_production.pdf

5.2.5. Metadata

Each dataset should be accompanied by INSPIRE conformal metadata. The minimum requirement is the metadata to be generated using the INSPIRE MetadataEditor:

http://inspire_geoportal.ec.europa.eu/editor/

6. Assessment of ecosystem services

6.1. Identification of indicators, parameters, data

Ecosystem service assessments of freshwater ecosystems in various temporal and spatial scales can support the production of maps of ecosystem services suppy and/or demand areas, quantify the possibility and its probable external impact on ecosystem functions, and understand the value and flow of benefits to human populations.

The assessment of ecosystem services in freshwater ecosystems focuses on indicators of final ecosystem services as developed in MAES (2013). The indicators and parameters for assessing the ecosystem services of freshwater ecosystems are listed in Table 7. The complete list of ES indicators which are relevant in each subtype of freshwater ecosystems can be found Annex 7. The indicators for most provisioning services are easier to identify than for most regulating and cultural services.

The indicators for ecosystem services were chosen in order to assess the services with relevance for the freshwater ecosystems from the CICES list of services, the classification scheme accepted by the MAES-initiative. As said above concerning the ecosystem condition indicators, after using the indicators for ecosystem services assessment listed in this methodology, the experts involved in the assessment may propose other new indicators for assessment of the services, that they consider as useful or more adequate for the purpose to comprehensively assess the ecosystem services that this ecosystem type provide. Such indicators, if any, must be used in the same methodological manner, as described in this methodology, and, after being tested, must be described and motivated proposals have to be made for their use in future assessment. Also comments and estimations regarding the usefulness and applicability of the indicators listed in this methodology have to be made, on a basis of the experience acquired in their use by the experts performing the assessment.

In the case of cultural services, the most frequent indicator is the number of visitors to the lake, river or wetland. In that case, the specific reason of the visit can describe the service at a higher level of detail of the CICES classification. However, it is often impossible to distinguish between several services, such as entertainment and aesthetic, or cultural and educational, and in many cases the motivation for the visit is a mix of several reasons. Since the information on the number of visitors is often not available, mapping the areas of interest for different cultural services can be used as proxy. Examples are: mapping parks, protected areas, bike and walk paths and sacred sites in the vicinity of lakes, rivers and wetlands, natural springs and thermal sites, bird watching sites, beaches and contrasting landscapes. However, mapping contrasting landscapes, parks or areas of interest shows the capacity to deliver a service, while the number of visitors gives information about the use (flow) of a service. The abundance of fish or waterfowls indirectly indicates the interest for the area, assuming that the higher the abundance the higher is the interest or value; this could be the case for example for fishermen and hunters.

Finally, the map of monitoring sites for scientific purposes at lakes, rivers, groundwater basins and wetlands has been suggested as indicator of scientific cultural services. However, this only partially addresses the scientific interest for the site, as monitoring also depends on the investment in research and not only on the relevance of the specific site.

Table 7. Indicators for assessing and mapping Ecosystem Services of freshwater ecosystems (lakes and rivers)

Section	Division	Group	Class (CICES Codes)	Indicator *Measuring method*	Parameters and units	Data sourses	% error
Provisioning	Nutrition	Biomass	P4. Wild animals and their outputs (1114)	Heads of animals reared for hunting/ Fish stock	t/year; condition unit	Environmental Statistics; Ecosystem condition assessment	
			P6. Animals/fish from in-situ aquaculture (1116)	Fisheries, mussel farms, frogs, etc.	t/year; condition unit	Environmental Statistics; Ecosystem condition assessment	
		Water	P7. Surface water for drinking (1121)	Drinking water consumption by the population	l/day per capita	Water permits for the water body	Difference between permits issued and statistical data
			P8. Ground water for drinking (1122)	Consumption of groundwater	l/day per capita	Water permits for wells, groundwater permits, concessions	Difference between permits issued and statistical data
	Materials	Biomass	P10. Genetic materials from all biota (1213)	Export of genetic materials for pharmaceutical use; Number of species deposited in gen-banks	t/y; Nr.	Environmental Statistics; Ecosystem condition assessment (CPV code); statistic	
		Water	P11. Surface water for non-drinking purposes (1221)	Total gross freshwater abstraction from surface freshwater	mio m3/year	Water permits for the water body	Difference between permits issued and statistical data
			P12. Ground water for non-drinking purposes (1222)	Total gross freshwater abstraction from fresh groundwaters	mio m3/year	Water permits for the water body	Difference between permits issued and statistical data
	Energy	Biomass-based energy sources	P14. Plant-based resources for energy (1311)	Wood and plant biomass for potential use as energy source	m3/year	Permits ussued	
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	R1. Bio-remediation by micro-organisms, algae, plants, and animals (2111)	Direct analitical methods*	BOD5, oxygen (%, mg O2/l)	Environmental Statistics; Ecosystem condition assessment; Monitoring of the chemical state	

Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	R2. Filtration/ sequestration/storage/accumulation by micro-organisms, algae, plants, and animals (2112)	Direct analitical methods	N-P-C; concentra-tions, mg/l	Environmental Statistics; Ecosystem condition assessment; Monitoring of the chemical state	
		Mediation by ecosystems	R3. Filtration/ sequestration/storage/accumulation by ecosystems (2121)	Direct analitical methods	Concentrations in water, sediments and organisms	Environmental Statistics; Ecosystem condition assessment; Monitoring of the chemical state	
			R5. Dilution by atmosphere, freshwater and marine ecosystems (2122)	Direct analitical methods	BOD5, oxygen (%, mg O2/l)	Water permits issued for the water body	
	Mediation of flows	Mass flows	R7. Mass stabilisation and control of erosion rates (2211)	Area	ha	Water permits issued for the water body	
		Liquid flows	R9. Hydrological cycle and water flow maintenance (2221)	Water balance	m3/sec	Environmental Statistics; Ecosystem condition assessment	
			R10. Flood protection (2222)	Modelling	water levels/ flooded areas	Environmental Statistics; Ecosystem condition assessment	
	Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection	R14. Maintaining nursery populations and habitats (2312)	Biodiversity WFD Protected Areas, Nursery areas	area, ha	Y	
		Water conditions	R19. Ecological state/Chemical condition of freshwaters (2341)	Direct analitical methods	concentrations	Environmental Statistics; Ecosystem state assessment; Monitoring of the chemical state	
Cultural	Physical and intellectual interactions with biota, ecosystems and land-/seascapes [environmental settings]	Physical & experiential interactions	C1. Experiential use of plants, animals and land-/ seascapes in different environmental settings (3111)	Visitors	number	NA	
			C2. Physical use of land-/seascapes in different environmental settings (3112)	Visitors	number	NA	
		Intellectual and representative interactions	C3. Scientific (3121)	Conservation significance	Number of sites in protected areas (Ramsar wetlands,	Environmental Statistics	

Section	Division	Group	Class (CICES Codes)	Indicator *Measuring method*	Parameters and units	Data sourses	% error
Cultural	Physical and intellectual interactions with biota, ecosystems and land-/seascapes [environmental settings]	Intellectual and representative interactions			Natura2000 sites, reserves		
			C4. Educational (3122)	Conservation significance	Number of sites in protected areas (Ramsar wetlands, Natura2000 sites, reserves)	Environmental Statistics	
			C5. Heritage, cultural (3123)	Cultural value	Number of visitors	NA	
			C6. Entertainment (3124)	Fishing/angling	Number of visitors/anglers	Y	
			C7.Aesthetic (3125)	Aesthetic landscapes	Number of nature/water landscape photos uploaded on web portals	Y	
	Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes [environmental settings]	Spiritual and/or emblematic	C8. Symbolic (3231)	Symbolic species	Number of symbolic species	Y	
			C9. Sacred and/or religious (3232)	Number of visitors	Number of sites	Y	
		Other cultural outputs	C11. Existence (3241)	Direct analitical methods	Number of visitors	Y	
			C12. Bequest (3242)	Direct analitical methods	Number of visitors	Y	

Y – supported with data based on expert opinion
NA – no data available
* - data from direct measurement, both in-situ and/or in-camera/lab

6.2. Steps for assessment of ESS

Step 1: Indicators for Ecosystem services assessment for freshwaters

The ecosystem services assessment is often used as an approach for analysis of the social-ecological systems. Ecosystem services describe the relationship between nature and humans and refer broadly to the benefits people can obtain from ecosystems (including freshwater ecosystems) and thereby linking the social and the ecological systems. The human benefits from ecosystems are referred to as ecosystem services, a concept which includes 'provisioning services such as food, water, timber, and fibre; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide for example recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling.[4]

For sustainable water management, the ecosystem services approach can be important as it takes into account not only the provisioning services; i.e. the benefits in the form of goods, but also regulating and cultural services. The problem is not only linked to the valuation for services where no market exists but also to the services required for maintaining the system functionality in the future. However, only few regulating, maintenance, and cultural ecosystem services can be valued directly so far.

The present indicator set is designed in a way that supports the assessment of ecosystem services delivered by the ecosystems. Their relevance to the specific freshwater ecosystem type is assessed by the involved experts. Depending on the data availability, a rapid assessment of ecosystem services based on expert opinion at national and/or regional scale could be applied in accordance with the specifics of sub-types of freshwater ecosystems.

Step 2: Data collection – national datasets (see Annex 5)

Various methods could be implemented in assessing services in freshwater ecosystems, both providing primary data (from direct measurements) and secondary ones (result of data processing, calculations). Currently most of the data can be extracted from existing national and sub-national data sources. Methods for quantification of the uncertainty and validity of ES maps should be further explored.[5]

The following institutions and sources should be considered as possible data providers:

- *MOEW - ExEA – Basin Directorates*
- *CORINE project, national data bases*
- *National statistics*
- *Municipalities*
- *National Cadastre*
- *Scientific publications*
- *Projects reports*
- *In-situ data*
- *EU data sources*
- *Additional remote sensing data*
- *Direct surveys and interviews with experts*

[4] Millennium Ecosystem Assessment, MA 2005

[5] Hou Y, Burkhard B, Müller F (2013) Uncertainties in landscape analysis and ecosystem service assessment. J Environ Manage - https://doi.org/10.1016/j.jenvman.2012.12.002 and Chapter 6 of Burkhard & Maes (2017) Mapping Ecosystem Sevices - http://ab.pensoft.net/articles.php?id=12837

Step 3: Assessment method

For the estimation of ecosystem services provided by given sub type of ecosystem the ecosystem service matrix should be used. It consist of ecosystem services (currently 19 regulating, 8 provisioning and 11 cultural services; according to Table 7) on the x-axis and geobiophysical spatial units (e.g. the CORINE8 land cover types used here) on the y-axis. At the intersections, the different spatial units' ecosystem service potentials were assessed on a scale from 1 (Low relevant *capacity*) to 5 (*very high relevant capacity*) for a hypothetical 'normal' European landscape at one time point in summer before harvest. The normalization to this relative 1-5 scale aims at making different ecosystem services (measured and assessed by various indicators and units) comparable with each other (Burkhard et al. 2014).

For all relevant services experts should assign score from 1 to 5 to each parameter, where 1 is consistent with the lowest level of the grading criterion, and 5 is the highest level. Scores should be assigned on the basis of group consensus after discussions. The dimensions of the intervals depend on the specific characteristics of the indicator and should be defined by the expert based on scientifically sound approach. The scores should be filled in the corresponding field in table 8.

Table 8. Scoring table for fresh water ecosystem services assessment

FRESHWATER ECOSYSTEMS							Assesment scale and score				
Section	**Division**	**Group**	**Class**	**Indicator**	**Parameters & units**	**Data sources**	**Score 1**	**Score 2**	**Score 3**	**Score 4**	**Score 5**
Provisioning	Nutrition	Biomass	P4. Wild animals and their outputs (1114)	Heads of animals reared for hunting/ Fish stock	t/year; kg/ha	Fishery Agency					
			P6. Animals/fish from in-situ aquaculture (1116)	Fisheries, mussel farms, frogs, etc.	t/year	Fishery Agency					
		Water	P7. Surface water for drinking (1121)	Drinking water consumption by the population	l/day per capita	RBDs, WaterSupply Agencies					
			P8. Ground water for drinking (1122)	Consumption of groundwater	l/day per capita	RBDs, WaterSupply Agencies					
			P10. Genetic materials from all biota (1213)	Export of genetic materials for pharmaceutical use; Number of species deposited in gen-banks	t/y Nr.	National gene-bank					
		Water	P11. Surface water for non-drinking purposes (1221)	Total gross freshwater abstraction from fresh surface water	mill m3/year	RBDs					
			P12. Ground water for non-drinking purposes (1122)	Total gross freshwater abstraction from fresh ground waters	mill m3/year	RBDs					
	Energy	Biomass-based energy sources	P14. Plant-based resources for energy (1311)	Wood and plant biomass for potential use as energy source	m3/year	Forestry Agency					

FRESHWATER ECOSYSTEMS							Assesment scale and score				
Section	**Division**	**Group**	**Class**	**Indicator**	**Parameters & units**	**Data sources**	**Score 1**	**Score 2**	**Score 3**	**Score 4**	**Score 5**
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	R1. Bio-remediation by micro-organisms, algae, plants, and animals (2111)	Rate of selfpurification/ biodegradation processes in water bodies	BOD5/ oxidation; oxygen content/ saturation (%, mg O2/l)	EEA & Regional Labs; RBDs					
			R2. Filtration/ sequestration/ storage/accumulation by micro-organisms, algae, plants, and animals (2112)	Removal of hazardous pollutants through by accumulation in sediments and bodies of aquatic organisms	heavy metals & priority substances concentrations, mg/l	EEA & Regional Labs; RBDs					
		Mediation by ecosystems	R3. Filtration/ sequestration/storage /accumulation by ecosystems (2121)	Direct analitical methods	N-P-C concentrations in water, sediments, organisms	EEA & Regional Labs; RBDs					
			R5. Dilution by atmosphere, freshwater and marine ecosystems (2122)	Direct analitical methods	BOD5, oxygen (%, mg O2/l)	EEA & Regional Labs; RBDs					
	Mediation of flows	Mass flows	R7. Mass stabilisation and control of erosion rates (2211)	Area	ha	RBDs					
		Liquid flows	R9. Hydrological cycle and water flow maintenance (2221)	Water balance	m3/sec	RBDs, NIMH					
			R10. Flood protection (2222)	modelling	water levels/flooded areas	RBDs, NIMH					
			R14. Maintaining nursery populations and habitats (2312)	Biodiversity WFD Protected Areas, Nursery areas	area, ha	RBDs, IBER					
		Water conditions	R19. Chemical condition of freshwaters (2341)	Direct analitical methods	concentrations	RBDs, NIMH					
Cultural	Physical and intellectual interactions with biota, ecosystems, and land -/seascapes [environmental settings]	Physical and experiential interactions	C1. Experiential use of plants, animals and land-/seascapes in different environmental settings (3111)	visitors	number						
			C2. Physical use of land-/seascapes in different environmental settings (3112)	visitors	number						
		Intellectual and representative interactions	C3. Scientific (3121)	Conservation significance	Number of sites in protected areas	EEA					
			C4. Educational (3122)	Conservation significance	Number of sites in protected areas	EEA					
			C5. Heritage, cultural (3123)	Cultural value	Number of visitors	EEA,					

FRESHWATER ECOSYSTEMS							Assesment scale and score				
Section	Division	Group	Class	Indicator	Parameters & units	Data sources	Score 1	Score 2	Score 3	Score 4	Score 5
Cultural	Physical and intellectual interactions with biota, ecosystems, and land-/seascapes	Intellectual and representative interactions	C6. Entertainment (3124)	Fishing/angling	Number of visitors						
			C7.Aesthetic (3125)	Aesthetic landscapes	Number of nature/water landscape photos uploaded on web portals						
	Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes [environmental settings]	Spiritual and/or emblematic	C8. Symbolic (3231)	Symbolic species	Number of symbolic species						
			C9. Sacred and/or religious (3232)	Number of visitors	Number of sites						
		Other cultural outputs	C11. Existence (3241)	Direct analitical methods	Number of visitors						
			C12. Bequest (3242)	Direct analitical methods	Number of visitors						

1 = low relevant capacity, 2 = relevant capacity, 3 = medium relevant capacity, 4 - high relevant capacity and 5 = very high relevant capacity

The assessment scale and score is based on parameters (measured and/or available statistical data) and presents expert evaluations of the parameter`s dimensions, as an average on national scale, and can be seen as research hypotheses which are to be tested in further case study applications with data from measurements, modelling or additional expert assumptions.

Step 4: Filling the matrix

Each ecosystem service relevant to and provided by freshwater ecosystems should be assessed at national level. After analyzing the information for the listed indicators of relevant ecosystem services from the different types of freshwater ecosystems (see Table. 2), the lowest and the highest values should be determined at national level. Same approach could be applied at regional level (following Eurostat NUTS 2 regions for Bulgaria[6]) for more precise studies.

[6] http://ec.europa.eu/eurostat/documents/3859598/5916917/KS-RA-11-011-EN.PDF

Table 9. Example matrix of scores given to each class of ESS (Table 8) presented by ES subtype (Table 2)

	ECOSYSTEMS SUB-TYPES	FRESHWATER ECOSYSTEMS
		C2.2
Ecosystems services class code	P4	4
	P6	3
	P7	2
	P8	4
	P11	5
	P12	3
	P14	2
	R1	3
	R2	4
	R3	4
	R5	4
	R7	4
	R9	3
	R10	4
	R14	5
	R19	4
	C1	3
	C3	3
	C4	2
	C5	2
	C6	4
	C7	5
	C8	1
	C9	1
	C11	4
	C12	4

The assessment scale reaches: 1 = low relevant capacity, 2 = relevant capacity, 3 = medium relevant capacity, 4 = high relevant capacity and 5 = very high relevant capacity.

The ecosystem service matrix at national level consists of relevant ecosystem services (extracted from the table in annex 7) on the y-axis and each freshwater ecosystem sub-type (from C1…. to C2…) on the x-axis. At the intersections, the different freshwater sub-type for realized ecosystem service supply should be assessed on a scale from 0 (no relevant supply) to 5 (maximum relevant supply) for a hypothetical 'normal' freshwater ecosystem defined by the experts at regional (national) level after completing step 3, having into consideration the complexity of freshwater ecosystems and their specifics. The score (1 to 5) obtained in Table 9 should be used as basis to define the scores for each ecosystem service and the relevant ecosystem subtypes and the results should be filled in Table 10. All services which are defined as not relevant for particular freshwater ecosystem subtypes (see annex 7)

will have 0 score in table 10. Furthermore, the ecosystem services marked as N.A. “no data available” in annex 7 will have 0 score. The normalization through the relative 0-5 scale aims at making different ecosystem services (measured and assessed by various indicators and units) comparable with each other. The values obtained in the matrix are useful for detailed mapping of pilots and monitored regions (see Monitoring Guide). It should be underlined that these values are indicative only for freshwater ecosystems.

Table 10. Summarized data for the freshwater ecosystem subtypes at national level (example values are given in the red row).

		Freshwater ecosystem subtypes													
	CICES	**C1.1**	**C1.2**	**C1.3**	**C1.5**	**C1.6**	**C2.1**	**C2.2**	**C2.3**	**C2.5**	**X01**	**X03**	**J5.2**	**J5.3**	**J5.4**
ESs class codes CICES	1111														
	1112														
	1113														
	1114														
	1115														
	1116														
	1121	5	4	0	0	0	5	4	3	2	0	0	0	0	0
	1122														
	1211														
	1212														
	1213														
	1221														
	1222														
	1311														
	1312														
	1321														
	2111														
	2112														
	2121														
	2122														
	2123														
	2211														
	2212														
	2221														
	2222														
	.....														
	.....														
	3241														
	3242														

The assessment scale reaches: 0 = no relevant capacity of the freshwater subtype to provide this particular ecosystem service, 1 = low relevant capacity, 2 = relevant capacity, 3 = medium relevant capacity, 4 = high relevant capacity and 5 = very high relevant capacity. *ES is not supported by data at national level and value 0 is additionally attributed and indicates the lack of data.

6.3. Mapping of Ecosystem services

The following section describes the procedure of mapping the ecosystem services, specifications of the final products for the maps and databases, and gives references to the Annexes to this document where database shema is provided in accordance to the specifications given hereafter.

6.3.1. Description of the mapping procedure

The workflow for mapping of ecosystem services follows the steps described in section 6.2. The technical characteristics of the geodatabase are provided in section 4 and should be applied also for mapping procedures in this section.

6.3.2. Data structure/schema

The data structure should follow the one provided in the Annex 9.00.

The schema of the database for the ecosystem services is presented in Figure 3:

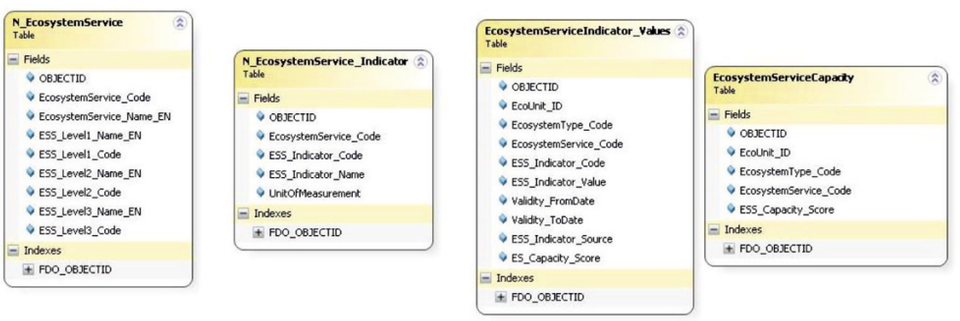


Figure 3: Ecosystem Services Database Schema

The detailed technical description of the classes and tables of the ecosystem services database is provided in Annex 9.01_Schema_Report_ES_Databace in file 9.01_1_Schema_Report_ES_Database.htm

The main steps of generation of the geodatabase should follow the steps described in section 6.2.:

- Table **"N_EcosystemService"**: Nomenclature table for ecosystem services. This table should not be changed. The nomenclatures are given in Annex 9.02_NOMENCLATURES_XLS / N_EcosystemService.xls. It has the following fields:

  - EcosystemService_Code: integer codes for ecosystem services at level 4;
  - EcosystemService_Name_EN: names in English of services at level 4;
  - ESS_Level1_Name_EN: names in English of ecosystem services at level 1;
  - ESS_Level1_Code: integer code of ecosystem services at level 1;
  - ESS_Level2_Name_EN: names in English of ecosystem services at level 2;
  - ESS_Level2_Code: integer code of ecosystem services at level 2;
  - ESS_Level3_Name_EN: names in English of ecosystem services at level 3;
  - ESS_Level3_Code: integer code of ecosystem services at level 3;

- Table "**N_EcosystemService_Indicator**": Nomenclature table of indicators used to determine the ecosystem services. The nomenclatures are given in Annex 9.02_NOMENCLATURES_XLS / N_EcosystemService_Indicator.xls. It has the following fields:

- EcosystemService_Code: integer codes for ecosystem service at level 4;

- ESS_Indicator_Code: integer codes for indicators used to assess the ecosystem services at level 4;

- ESS_Indicator_Name: name of indicators used to assess the ecosystem services at level 4;

- UnitOfMeasurement: units of measurement for each indicator.

This nomenclature table should be generated using the example provided in Annex 9.02_NOMENCLATURES_XLS / N_EcosystemService_Indicator.xls, as well as the table 7 Additional optional indicators, which could be applied in assessing and mapping ESs in XXX ecosystems from this methodology.

- Table "**EcosystemServiceIndicator_Values**": This table is the resulting table from the assessment of the ecosystem services. How to perform the work on assessment of the indicators is described in Step 3 in section 6.2:

- EcoUnit_ID: field to relate with the feature class;

- EcosystemType_Code: integer codes for ecosystem types at level 3;

- EcosystemService_Code: integer codes for ecosystem service at level 4;

- ESS_Indicator_Code integer codes for indicators used to assess the ecosystem services at level 4;

- ESS_Indicator _Value: value of calculated indicator used to assess the ecosystem service at level 4;

- Validity_FromDate: starting date for validity of the indicator;

- Validity_ToDate: end date for validity of the indicator;

- ESS_Indicator_Source: free text to describe the source of the data used to calculate the value of the indicator;

- ES_Capacity_Score: calculated value for ES; how to define the score for each indicator is explained in Chapter 6.2. / Step 1;

As this resulting table could contain enormous number of records which some GIS software could not support it is acceptable to separate it into smaller tables. In this case the records in the table should be separated based on the ecosystem types at level 3. The naming of the table should be done in the following way:

"**EcosystemServiceIndicator_Values_XXX**" – where XXX is the code of the ecosystem type at level 3.

- Table "**EcosystemServiceCapacity**": As for some services more than one indicator could be selected for measurement, additional table is required which represents the total score for each service calculated from the total score of indicators measured. Because some of the indicators could be more important than others, it is of responsibility of the expert to choose what will be the final score based on the values of the indicators calculated:

- EcoUnit_ID: field to relate with the feature class;

- EcosystemType_Code: integer codes for ecosystem types at level 3;

- EcosystemService_Code: integer codes for ecosystem service at level 4;

- ESS_Capacity_Score: final score for each service calculated on the bases of all indicators selected for its evaluation. The values here should be between 1 and 5 and 0 for not relevant capacity;

In order the database to be more informative, one table for each service at level 4 should be prepared and named as follows: "**EcosystemServiceCapacity_ZZZ**" where ZZZ is the code for services at level 4.

6.3.3. Accuracy and validation

The expert should provide scientifically sound approach to describe the accuracy reached for each ecosystem service indicator; hence validation approach should be applied. For each validation, accuracy reports should be generated and provided.

6.3.4. Digital Maps for Ecosystem Services

Maps in scale 1:125 000 for the ecosystem types should be delivered in PDF at size A2 presenting the results from calculation for Ecosystem Capacity. In addition the maps could also be prepared in paper format in the same size.

Each data frame should contain one cell from the EEA reference grid at 50 km, hence up to 77 maps could be produced for all the cells from the 50km EEA gird for Bulgaria. In case that no polygons from Feature Class "EcoUnit" fall in certain cell, map for this cell should not be delivered. Therefore, the actual number of maps to be delivered will depend on the number of cells that contain at least one polygon from Feature "Class EcoUnit". The EEA reference grid is available at:

http://www.eea.europa.eu/data-and-maps/data/eea-reference-grids/

At least one set of maps for the ecosystem services should be prepared. The maps representing the results for calculating the ecosystem services capacity is mandatory. For visualization of the capacity graduated colors corresponding to the colors in example matrix table (table 10) should be used. Six classes should be generated as follows: 0 - no relevant capacity of the freshwater sub-type type to provide this particular ecosystem service, 1 - low relevant capacity, 2 - relevant capacity, 3 - medium relevant capacity, 4 - high relevant capacity and 5 - very high relevant capacity.

The layout of the maps of the ecosystem services should follow the guidelines of EEA:

http://www.eionet.europa.eu/gis/docs/GISguide_v4_EEA_Layout_for_map_production.pdf

6.3.5. Metadata

Each dataset should be accompanied by INSPIRE conformal metadata. The minimum requirement is the metadata to be generated using the INSPIRE MetadataEditor:

http://inspire-geoportal.ec.europa.eu/editor/

ANNEX 1 - B8

Terms and definitions

Term	Definition
Freshwater ecosystems (Rivers and Lakes)	
Animal (bio)diversity	The diversity of heterotrophic organisms (consumers) measured by number of species, taxonomic and/or functional groups
Assessment	The analysis and review of information derived from research for the purpose of helping someone in a position of responsibility to evaluate possible actions or think about a problem. Assessment means assembling, summarising, organising, interpreting, and possibly reconciling pieces of existing knowledge and communicating them so that they are relevant and helpful to an intelligent but inexpert decision-maker (Parson, 1995).
Benefits	In biology, benefit is enhancement of growth, maintenance, or reproduction of an organism, population, community or ecosystem. It is also accepted as a positive change in wellbeing from the fulfilment of needs and wants (TEEB, 2010) with respect to production, distribution, and consumption of goods and services
Biodiversity	The variability among living organisms from all sources, including inter alia terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part, this includes diversity within species, between species, and of ecosystems (cf. Article 2 of the Convention on Biological Diversity, 1992).
Biological Quality Elements (BQRs)	Biological Quality Elements for classification of the ecological status are defined for each of the categories of water bodies defined under the WFD, Annex V: rivers (1.1.1), lakes (1.1.2), transitional (brackish) water (1.1.3) and (marine) coastal waters (1.1.4).
Biophysical valuation	A method that derives values from measurements of the physical costs (e.g., surface requirements, labour, biophysical processes, mate rial inputs).
Consumers	In the food chain of the ecosystems consumers are organisms of an ecological chain that receive energy by consuming other organisms. These organisms are formally referred to as heterotrophs, which include animals, bacteria and fungus.
Density of vegetation cover	Density of macroalgae/vascular plant covering on the bottom surface of a water body.
Drivers of change	Any natural or human-induced factor that directly or indirectly causes a change in an ecosystem. A direct driver of change unequivocally influences ecosystem processes and can therefore be identified and measured by different degrees of accuracy; an indirect driver of change operates by altering the level or rate of change of one or more direct drivers (MA, 2005).
Ecological status	An expression of the quality of the structure and functioning of aquatic ecosystems associated with surface waters, classified in accordance with Annex V of the WFD 2000/60/EPC.

Ecological quality ratio (EQR)	In order to ensure comparability of monitoring systems, the results shall be expressed as ecological quality ratios for the purposes of classification of ecological status. These ratios shall represent the relationship between the values of the biological parameters observed for a given body of surface water and the values for these parameters in the reference conditions applicable to that body. The ratio shall be expressed as a numerical value between zero and one, with high ecological status represented by values close to one and bad ecological status by values close to zero (see WFD, Annex V, 1.4.11ii).
Economic valuation	The process of expressing a value for a particular good or service in a certain context (e.g., of decision-making) in monetary terms (TEEB, 2010).
Ecosystem	A dynamic complex of plant, animal, and microorganism communities and their non-living environment interacting as a functional unit (MA, 2005). For practical purposes it is important to define the spatial dimensions of concern.
Ecosystem assessment	A social process through which the findings of science concerning the causes of ecosystem change, their consequences for human well-being, and management and policy options are brought to bear on the needs of decision-makers (UK NEA, 2011).
Ecosystem condition	The capacity of an ecosystem to yield services, relative to its potential capacity (MA, 2005). For the purpose of MAES, ecosystem condition is, however, usually used as a synonym for 'ecosystem state' (see the “ecological status” above)
Ecosystem function	Subset of the interactions between biophysical structures, biodiversity and ecosystem processes that underpin the capacity of an ecosystem to provide ecosystem services (TEEB, 2010).
Ecosystem process	Any change or reaction, which occurs within ecosystems, physical, chemical or biological. Ecosystem processes include decomposition, production, nutrient cycling, and fluxes of nutrients and energy (MA, 2005).
Ecosystem service	The benefits that people obtain from ecosystems (MA, 2005). The direct and indirect contributions of ecosystems to human well-being (TEEB, 2010). The concept 'ecosystem goods and services' is synonymous with ecosystem services. The service flow in MAES conceptual framework refers to the actually used service.
Ecosystem state	The physical, chemical and biological condition of an ecosystem at a particular point in time which can also be referred to as its quality. In freshwater
Eutrophication	The ecosystem response to the addition of artificial or natural substances, mainly phosphates, through detergents, fertilizers, or sewage, to an aquatic system
Floods	Number of recorded floods per year and % damaged areas of the total area
Fragmentation	Fragmented habitats are those that were once contiguous but are now separated into smaller, isolated areas.

Functional groups of the species and their relative frequency	Set of species in given community constitute a functional group if they have similar functional characteristics related to one ecosystem service. This dependence on ecosystem service is defined by theoretical framework or by empirical evidence. Functional groups in vegetation science are known as plant functional types and in animal science as guilds. Relative frequency - relative representation of a functional group in a particular ecosystem.
Habitat	The physical location or type of environment in which an organism or biological population lives or occurs. Terrestrial or aquatic areas distinguished by geographic, abiotic and biotic features, whether entirely natural or seminatural.
Habitat diversity	Number of natural habitats for specified area incl. protected habitats - Habitats Directive in 1992 (Council Directive 92/43/EEC of 21 May 1992)
Indicator	Observed value representative of a phenomenon to study. In general, indicators quantify information by aggregating different and multiple data. The resulting information is therefore synthesised.
Invasives (plants, animals)	Invasive alien species (IAS) are non-native species that are deliberately or unintentionally introduced by human action outside their natural habitats where they establish, proliferate and spread in ways that cause damage to biological diversity.
Land cover	Land cover is the observed (bio) physical cover on the earth's surface.
Lake	A body of standing inland surface water
Macrozoobenthos	Invertebrate bottom fauna living on, or in the bottom, which is retained on a sieve with a mesh size of 1 mm x 1 mm
Management plan	A predetermined course of action and direction to achieve a set of results, usually specified as goals, objectives, and policies
Nutrients	In environmental researches the term refers to inorganic chemical elements consumed by plants in large quantities, primarily carbon, nitrogen and phosphorus
Phytoplankton	Autotrophic components of the plankton community and a key factor of oceans, seas and freshwater (rivers and/or lakes) ecosystems. The name comes from the Greek words φυτόν (*phyton*), meaning “plant”, and πλαγκτός (*planktos*), meaning "wanderer" or "drifter". Most of the phyto-plankters are too small to be individually seen with the unaided eye. However, when present in high enough numbers, they may appear as a green discoloration of the water due to the presence of chlorophyll within their cells (although the actual color may vary with the species of phytoplankton present due to varying levels of chlorophyll or the presence of accessory pigments.
Plankton	A group of diverse organisms that live in the water column and cannot swim against a current. They provide a crucial source of food to many large aquatic organisms, such as fish, jellyfish etc.
Plant (bio)diversity	The diversity of autotrophic/photosynthetic organisms, both vascular and algae, measured by number of species, taxonomic and/or functional groups in a specified area/volume

Pollution/Pollutant	The direct or indirect introduction, as a result of human activity, of substances or heat into the air, water or land which may be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems, which result in damage to material property, or which impair or interfere with amenities and other legitimate uses of the environment. “Pollutant” means any substance liable to cause pollution (in particular those listed in Annex VIII of the WFD 2000/60/EPC)
Primary producers	Organisms in an ecosystem that produce biomass from inorganic compounds. In almost all cases these are photosynthetically active organisms (plants, cyanobacteria and a number of other unicellular organisms)
Protected species and habitats	See Habitats Directive in 1992 (Council Directive 92/43/EEC of 21 May 1992), and Marine Strategy Framework Directive (Council Directive 2008/56/EC of 15 July 2008).
Restoration	Refers to the process of actively managing the recovery of an ecosystem that has been degraded, damaged or destroyed as a means of sustaining ecosystem resilience and conserving biodiversity (CBD, 2012).
River	A body of inland water flowing for the most part on the surface of the land but which may flow underground for part of its course .
Species diversity	Number of plant or/and animal species for specified area incl. protected species - Habitats Directive in 1992 (Council Directive 92/43/EEC of 21 May 1992) and Birds Directive (Directive 2009/147/EC)
Value	The contribution of an action or object to user-specified goals, objectives, or conditions (MA, 2005).
Water body	A body of surface water as a discrete and significant element of surface water such as a lake, a reservoir, a stream, river or canal, part of a stream, river or canal, a transitional water or a stretch of coastal water (WFD 2000/60/EPC)
Waters for shellfish farming	BG Ordinance № 4/20.10.2000 г. on the quality of waters used for fish- and shellfish cultures

ANNEX 2 - B8

List of acronyms

BESS	Biodiversity & Ecosystem Service Sustainability
BFSA	Bulgarian Food Safety Agency
BSBP	Biodiversity Planning Support Programme
BQE	Biological Quality Element(s)
CBD	Convention on Biological Diversity
CICES	Common International Classification of Ecosystem Services
CLC	CORINE Land Cover
CORINE	Coordination of Information on the Environment
EAE	Executive Agency for the Environment
EC	European Commission
EEA	European Environment Agency
EEA FM	European Economic Area Financial Mechanism
EFA	Executive Forestry Agency
EFDAC	European Forest Data Centre
EnvEurope	The project “Environmental quality & pressures assessment across Europe: the LTER network as an integrated and shared system for ecosystem monitoring”
FRAME	Directive on Floods Risk Assessment & Management 2007/60/EEC
ES	Ecosystem
ESC	Ecosystem Capacity
ESS	Ecosystem Services
EU	European Union
EUNIS	European University Nature Information System
EQR	Ecological Quality Ratio
GIS	Geographic Information System
GMES	Global Monitoring for Environment and Security programme
HD	Habitats Directive
IP	Index of ecosystem Performance
IPP	Institute for plant Protection
IPCC	Intergovernmental Panel on Climate Change
GPG LU	Good Practice Guidance for Land Use
LUCF	Land-Use Change and Forestry
JRC	Joint Research Centre
MA	Millennium Ecosystem Assessment
MAES	Mapping and Assessment of Ecosystems and their Services
MAF	Ministry of Agriculture and Food
ME	Ministry of Economy
MOEW	Ministry of Environment and Water
MRD	Ministry of Regional Fevelopment
MSFD	Marine Strategy Framework Directive
MTITC	Ministry of Transport, Information Technology and Communications
NEK EAD	National Electricity Company EAD

NCA	Natural Capital Accounts
NCRD	National Concept for Regional Development
NCSD	National Concept for Spatial Development
NGOs	Non-Governmental Organization(s)
OM	Organic Matter
OPERA project	Operational Potential of Ecosystems Research Applications
PAF	Priority Action Framework
PES	Payment for Environmental Services
RBDs	River Basins Directorate(s)
RES	Realized Ecosystem Capacity
RIEW	Regional Inspectorate of Environment and Water
SEEA	System of Environmental Economic Accounts
SEPA	Single Euro Payments Area
TEEB	The Economics of Ecosystems and Biodiversity
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNSC	United Nations Statistics Commission
WAVES	Wealth Accounting and the Valuation of Ecosystem Services
WFD	Water Framework Directive
WG	Working Group
WWF	World Wide Fund for Nature

ANNEX 3 - B8

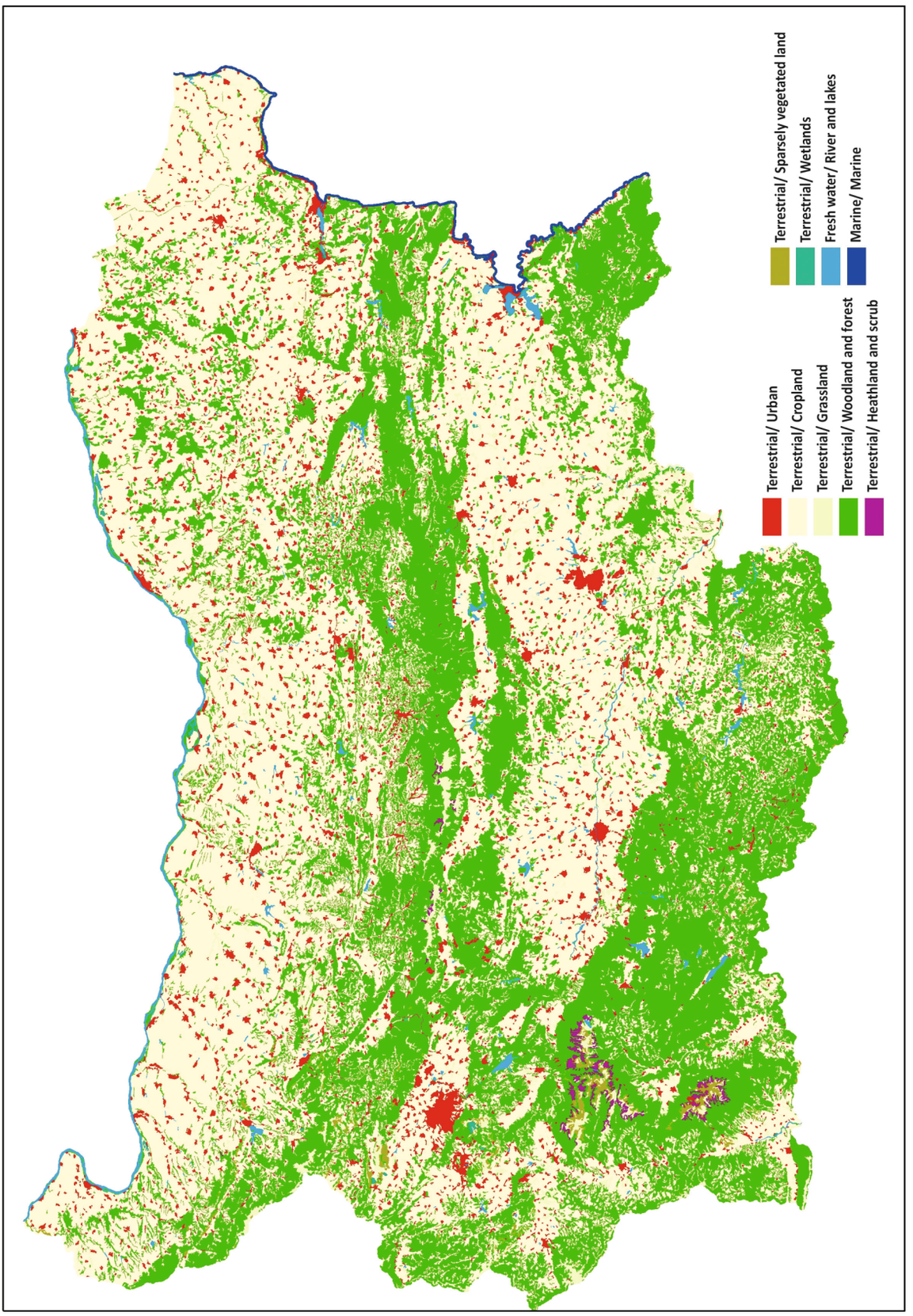
Table 1. Freshwater ecosystems typology in Bulgaria

Level 1 (Main categories of water ecosystems)	Level 2 (Subclasses)	Level 3 (Ecosystem types)
(INLAND SURFACE) FRESHWATER	**C1. LAKES** (Surface standing waters; water bodies, incl. coastal ones without permanent connection to the sea)	C1.1. Permanent oligotrophic lakes, ponds and pools C1.2. Permanent mesotrophic lakes, ponds and pools C1.3. Permanent eutrophic lakes, ponds and pools C1.5. Permanent inland saline and brackish lakes, ponds and pools C1.6. Temporary lakes, ponds and pools
	C2. RIVERS (water courses of all types, incl. artificial canals)	C2.1. Springs, spring brooks and geysers C2.2. Permanent non-tidal, fast, turbulent watercourses C2.3. Permanent non-tidal, smooth-flowing watercourses C2.5. Temporary running waters
	X01.ESTUARIES	Downstream part of a river valley, extending from the limit of brackish waters. River estuaries are coastal inlets where there is generally a substantial freshwater influence. The mixing of freshwater and sea water and the reduced current flows in the shelter of the estuary lead to deposition of fine sediments. Littoral and sublittoral habitat types typical of estuaries are included in A2 and A5, although many other habitat types including tidal rivers may occur in estuaries. **Includes Transitional waters as defined by the WFD**.
	X03. BRACKISH COASTAL LAGOONS	Lagoons are expanded of shallow coastal salt water, of varying salinity and water volume, wholly or partially separated from the sea by sand banks or shingle, or, less frequently, by rocks. Fully saline coastal lagoons are classified as X02
TERRESTRIAL	**J5.** Highly artificial **MAN-MADE WATERS** and associated structures**	J5.2. Highly artificial saline and brackish running waters J5.3. Highly artificial non-saline standing waters J5.4. Highly artificial non-saline running waters

* Seems not represented in that country ;
** Should be accepted as artificial/heavily modified water bodies, WFD 2000/60/EC, Annex V, Art. 2, items 8 and 9.

ANNEX 4 - B8

Map of ecosystem types



ANNEX 5 - B8

National data sets

Table 3. **Sources of spatial and quantitative/qualitative database on freshwaters**

		DATABASE Sources – main stakeholders	
	Subtype Level 2	**Spatial**	**Quantitative/Qualitative**
C1.	**LAKES** (Surface standing waters)	Database EUNIS Level 2 (VV), NATURA-2000 mapping, National Concept for Spatial Development 2013-2025; Rivers Basins Management Plans 2009-2015 and next issues (draft of 2016-2021) Preliminary Flood Risk Assessments (MOEW/RBDs) Floods Risk management Plans (under development) (MOEW/RBDs)	National Monitoring of Biodiversity + NATURA 2000; Action Plans for Programs of Environmental protection; National Concept for Spatial Development 2013-2025, National Statistical Institute, Monitoring reports and data bases (MOEW/EEA/RBDs/ RIEW, MRD, EAFA), Publications, Reports of Research Projects.
C2.	**RIVERS** (Water courses)	Database EUNIS Level 2 (VV), NATURA-2000 mapping, National Concept for Spatial Development 2013-2025 Rivers Basins Management Plans 2009-2015 and next issues (draft of 2016-2021) Preliminary Flood Risk Assessments (MOEW/RBDs) Floods Risk management Plans (under development) (MOEW/RBDs)	National Monitoring of Biodiversity + NATURA 2000; Action Plans for Programs of Environmental protection, National Concept for Spatial Development 2013-2025, National Statistical Institute, Water Monitoring reports and data bases (MOEW/EEA/RBDs/ RIEW, MRD, EAFA), Publications, Reports of Research Projects.

		DATABASE Sources – main stakeholders	
	Subtype Level 2	**Spatial**	**Quantitative/Qualitative**
X01	**Estuaries**	Database EUNIS Level 2 (VV), NATURA-2000 mapping, National Concept for Spatial Development 2013-2025 Rivers Basins Management Plans 2009-2015 and next issues (draft of 2016-2021) Preliminary Flood Risk Assessments (MOEW/RBDs) Floods Risk management Plans (under development) (MOEW/RBDs)	National Monitoring of Biodiversity + NATURA 2000; NATURA-2000 mapping, National Concept for Spatial Development 2013-2025 Rivers Basins Management Plans 2009-2015 and next issues (draft of 2016-2021) Preliminary Flood Risk Assessments (MOEW/RBDs) Floods Risk management Plans (under development) (MOEW/RBDs)
X03	**Brackish Coastal Lagoons**	Database EUNIS Level 2 (VV), NATURA-2000 mapping, National Concept for Spatial Development 2013-2025 Rivers Basins Management Plans 2009-2015 and next issues (draft of 2016-2021) Preliminary Flood Risk Assessments (MOEW/RBDs) Floods Risk Management Plans (under development) (MOEW/RBDs)	National Monitoring of Biodiversity + NATURA 2000; River Basins Management Plans; Flood Risk Management Plans, Action Plans for Programs of Environmental protection, National Concept for Spatial Development 2013-2025, National Statistical Institute, Monitoring reports and data bases (MOEW/EEA/BSBD/ RIOEW, MRD, EAFA), Publications, Reports of Research Projects.

ANNEX 6 - B8

Available as a spreadsheet at:
http://www.metecosmap-sofia.org/methodological-framework/

ECOSYSTEM CONDITION INDICATORS

Ecological condition indicators			FRESHWATER ECOSYSTEMS								
			Lakes (sub-class C1)			Rivers (sub-class C2)			Estuaries (X_01) & Brackish Coastal Lagoons (X_03)		
Orientor		Indicandum	Parameters	Dimentions (units)	Periodicity of measuring (years etc.)	Parameters	Dimentions (units)	Periodicity of measuring (years etc.)	Parameters	Dimentions (units)	Periodicity of measurring (years etc.)
Ecosytem structure	Biotic Heterogeneity	plant diversity (both phytoplankton/ phytobenthos and macrophytes)	**algal groups index (phytoplankton only)**	**number / density / ratio**	**1/6 mnts**	**diatom index (IPS)**	**number**	**1/3 yrs**	**algal groups index (phytoplankton only)**	**number / density / ratio**	**1/6 mnts**
			number of endangered/ rare species	**number / density / ratio**	**1/3 yrs**	**number of endangered/ rare species**	**number / density / ratio**	**1/3 yrs**	**number of endangered/ rare species**	**number / density / ratio**	**1/3 yrs**
			total/relative number of species	**number / density / ratio**	**1/3 yrs**	**total/relative number of species**	**number / density / ratio**	**1/3 yrs**	**total/relative number of species**	**number / density / ratio**	**1/3 yrs**
			macrophytes referent index	**number /**	**1/3 yrs**	**macrophytes referent index**	**number /**	**1/3 yrs**	**macrophytes referent index**	**number /**	**1/3 yrs**
			chlorophyll A	**mg/m3**	**1/6 mnts**	**chlorophyll A (only for Danube River)**	**mg/m3**		**chlorophyll A**	**mg/m3**	**1/6 mnts**
			biomass (for phytoplankton only)	g/m3	1/6 mnts	biomass (for phytoplankton only)	g/m3	1/6 mnts	biomass (for phytoplankton only)	g/m3	1/6 mnts
		animal diversity (both macroinvertebrates and fish)	**number of protected species**	**number / density / ratio**	**1/3 yrs**	**number of protected species**	**number / density / ratio**	**1/3 yrs**	**number of protected species**	**number / density / ratio**	**1/3 yrs**
			number of endangered/ rare species	**number / density / ratio**	**1/3 yrs**	**number of endangered/ rare species**	**number / density / ratio**	**1/3 yrs**	**number of endangered/ rare species**	**number / density / ratio**	**1/3 yrs**
			total/relative number of species	**number / density / ratio**	**1/3 yrs**	**total/relative number of species**	**number / density / ratio**	**1/3 yrs**	**total/relative number of species**	**number / density / ratio**	**1/3 yrs**
			age structure (for fish only)	**number / density / ratio**	**1/3 yrs**	**age structure (for fish only)**	**number / density / ratio**	**1/3 yrs**	**age structure (for fish only)**	**number / density / ratio**	**1/3 yrs**
		habitat diversity	**bottom substrate type**	**simbol**	**1/6 YRS**	**bottom substrate type**	**simbol**	**1/6 YRS**	**bottom substrate type**	**simbol**	**1/6 YRS**
			water flow/curent/ discharge /volume	**m3; m3/sec**	**4/1 year**	**water flow/curent/ discharge /volume**	**m3; m3/sec**	**4/1 year**	**water flow/curent/ discharge /volume**	**m3; m3/sec**	**4/1 year**
			depth	**number**	**4/1 year**	**depth**	**number**	**4/1 year**	**depth**	**number**	**4/1 year**
			transparency / turbidity	**number**	**4/1 year**	**transparency / turbidity**	**number**	**4/1 year**	**transparency / turbidity**	**number**	**4/1 year**
		Invasive species	**number of invasive species**	**number / ratio**	**1/3 yrs**	**number of invasive species**	**number / ratio**	**1/3 yrs**	**number of invasive species**	**number / ratio**	**1/3 yrs**
			abundance / density	number	1/3 yrs	abundance / density	number	1/3 yrs	abundance / density	number	1/3 yrs
		Other biotic heterrogeity indicators (naturalness etc.)				**trophic structure of community**	**number / ratio**	**1/3 yrs**	**trophic structure of community**	**number / ratio**	**1/3 yrs**
						adapted biotic index (ABI)	**number/ EQR**	**1/3 yrs**	**adapted biotic index (ABI)**	**number/ EQR**	**1/3 yrs**
						fish-based index	number/ EQR	1/3 yrs	fish-based index	number/ EQR	1/3 yrs

FRESHWATER ECOSYSTEMS												
Ecological condition indicators			Lakes (sub-class C1)			Rivers (sub-class C2)			Estuaries (X_01) & Brackish Coastal Lagoons (X_03)			
Orientor	Indicandum		Parameters	Dimentions (units)	Periodicity of measuring (years etc.)	Parameters	Dimentions (units)	Periodicity of measuring (years etc.)	Parameters	Dimentions (units)	Periodicity of measurring (years etc.)	
Ecosytem structure	Abiotic heterogeneity	Soil heterogeneity	NOT RELEVANT			NOT RELEVANT			NOT RELEVANT			
		Hydrological heterogeneity	**lake type**	**simbol (L_X)**	**const.**	**river type**	**simbol (R_X)**	**const.**	**transitional water type**	**simbol (R_X)**	**const.**	
			water volume/ level	**m3; cm**	**4/1 yrs**	**water velocity / discharge**	**m/sec; m3/sec**	**4/1 yrs**	**water level/ velocity/ discharge**	**m/sec; m3/sec**	**4/1 yrs**	
			bottom substrate type	**simbol**	**1/6 yrs**	**bottom substrate type**	**simbol**	**1/6 YRS**	**bottom substrate type**	**simbol**	**1/6 YRS**	
			depth	**number**	**4/1 year**	**depth**	**number**	**4/1 year**	**depth**	**number**	**4/1 year**	
			transparency / turbidity	number	4/1 year	transparency / turbidity	number	4/1 year	transparency / turbidity	number	4/1 year	
			temperature	number	4/1 year	temperature	number	4/1 year	temperature	number	4/1 year	
		Air heterogeneity	NOT RELEVANT			NOT RELEVANT			NOT RELEVANT			
		Geomorphological heterogeneity	**bottom substrate type**	**simbol**	**1/6 YRS**	**bottom substrate type**	**simbol**	**1/6 YRS**	**Bottom substrate type**	**simbol**	**1/6 YRS**	
						barriers	**number**	**1/6 YRS**	**Barriers**	**number**	**1/6 YRS**	
			water pollution / contamination	**concentr**	**4/1 year**	**water pollution / contamination**	**concentr**		**Water pollution / contamination**	**concentr**		
						barrages	number	1/6 YRS	**barrages**	number		
			water intakes/ inflows /outflow	**m3; m3 per sec**	**4/1 year**	**water intakes/ inflows /outflow**	**m3; m3 per sec**	**1/6 YRS**	**bater intakes/ inflows /outflow**	**m3; m3 per sec**		
		Other abiotic heterogeneity indicators	**ecological status**	**EQR**	**1/3 yrs**	**ecological status**	**EQR**	**1/3 yrs**	**ecological status**	**EQR**	**1/3 yrs**	
			chemical status	**EQR**	**4/1 year**	**Chemical status**	**EQR**	**4/1 year**	**Chemical status**	**EQR**	**4/1 year**	
			hydro-morphological status	**EQR**	**1/6 YRS**	**Hydro-morphological status**	**EQR**	**1/6 YRS**	**Hydro-morphological status**	**EQR**	**1/6 YRS**	

FRESHWATER ECOSYSTEMS												
Ecological condition indicators			Lakes (sub-class C1)			Rivers (sub-class C2)			Estuaries (X_01) & Brackish Coastal Lagoons (X_03)			
Orientor	Indicandum		Parameters	Dimentions (units)	Periodicity of measuring (years etc.)	Parameters	Dimentions (units)	Periodicity of measuring (years etc.)	Parameters	Dimentions (units)	Periodicity of measurring (years etc.)	
Ecosystem processes	Energy budget	Energy balance (capture, storage)	Primary production	number / time	4/1 year				Primary production	number / time	4/1 year	
		Entropy production	**Shannon-Weaver's index of diversity of Biological Quality Elements (BQEs)**	**number**	**1/3 yrs**	**Shannon-Weaver's index of diversity of Biological Quality Elements (BQEs)**	**number**	**1/3 yrs**	**Shannon-Weaver's index of diversity of Biological Quality Elements (BQEs)**	**number**	**1/3 yrs**	
		metabolic efficiency	ratio of production/ destruction (P/R)	number / ratio	??				ratio of production/ destruction (P/R)	number / ratio	??	
			ratio of production/ biomass (P/B)	number / ratio	??				ratio of production/ biomass (P/B)	number / ratio	??	
		other energy budget indicators										
	Matter budget	matter balance (input, output)										
		element concentrations (other state variables)	**concentration of nutrients**	**number**	**4/1 year**	**concentration of nutrients**	**number**	**4/1 year**	**concentration of nutrients**	**number**	**4/1 year**	
			dangerous / hazardous pollutants	**number**	**4/1 year**	**dangerous / hazardous pollutants**	**number**	**4/1 year**	**dangerous / hazardous pollutants**	**number**	**4/1 year**	
			suspended matter	number	4/1 year	suspended matter	number	4/1 year	suspended matter	number	4/1 year	
		efficiency measures	yield of bioproduction	kg/km, kg/m3	??		kg/km, kg/m3	??		kg/km, kg/m3	??	
	Water budget	water balance (input, output)	**discharge / volume / level**	**ratio**	**cont**	**dynamics of water flows / discharge**	**m3; m3/sec**	**cont**	**discharge / volume / level**	**m3; m3/sec**	**cont**	
			water intakes/ inflows	**m3; m3 per sec**	**1/6 YRS**	**dater intakes/ inflows**	**m3; m3 per sec**	**1/6 YRS**	**water intakes/ inflows**	**m3; m3 per sec**	**1/6 YRS**	
		water storage	**volume**	**m^3**	**cont**				**Volume**	**m^3**	**cont**	
		other state indicators										
		efficiency measures										

* Obligatory indicators are bolded in blue

Available as a spreadsheet at:
http://www.metecosmap-sofia.org/methodological-framework/

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INDICATORS - FRESHWATER ECOSYSTEM SERVICES

Section	Division	Group	Class (CICES Code)	Indicator measuring method	Parameters and units	Data Sourse	C1.1. Permanent oligotrophic lakes, ponds and pools	C1.2. Permanent mesotrophic lakes, ponds and pools	C1.3. Permanent eutrophic lakes, ponds and pools	C1.5. Permanent inland saline and brackish lakes, ponds and pools	C1.6. Temporary lakes, ponds and pools	C2.1. Springs, spring brooks and geysers	C2.2. Permanent non-tidal, fast, turbulent water-courses
Provisioning	Nutrition	Biomass	P1. Cultivated crops (1111)	Harvest as % of country average depending on ecosystem state		Statistics; Ecosystem condition assessment	NR	NR	NR	NR	NR	NR	NR
			P2. Reared animals and their outputs (1112)	Yield as % of country average depending on ecosystem state		Statistics; Ecosystem condition assessment	NR	NR	NR	NR	NR	NR	NR
			P3. Wild plants, algae and their outputs (1113)	% of primary biomass production for food	t/ha	Statistics; Ecosystem condition assessment	NR	NR	NR	NR	NR	NR	NR
			P4. Wild animals and their outputs (1114)	**Heads of animals reared for hunting/ Fish stock**	**t/year; condition unit**	**Environmental Statistics; Ecosystem condition assessment**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
			P5. Plants and algae from in-situ aquaculture (1115)	Annual production	t/ha	Statistics; Ecosystem condition assessment	NA	NA	NA	NA	NA	NA	NA
			P6. Animals/fish from in-situ aquaculture (1116)	**Fisheries, mussel farms, frogs, etc.**	**t/year; condition unit**	**Environmental Statistics; Ecosystem condition assessment**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
		Water	**P7. Surface water for drinking (1121)**	**Drinking water consumption by the population**	**l/day per capita**	**Water permits for the water body**	**Y**	**Y**	**N**	**NA**	**NA**	**Y**	**Y**
			P8. Ground water for drinking (1122)	**Consumption of groundwater**	**l/day per capita**	**Water permits for wells, groundwater permits, concessions**	**NR**	**NR**	**NR**	**NR**	**NR**	**Y**	**Y**
	Materials	Biomass	P9. Fibres and other materials from plants, algae and animals for direct use or processing (1211)	Harvest/Yield as % of country average depending on ecosystem state % of primary biomass production for food Raw material inputs per capita Raw material consumption per capita	T/ha T per capita	Statistics; Ecosystem condition assessment	NR	NR	NR	NR	NR	NR	NR

Section	Division	Group	Class (CICES Code)	Indicator measuring method	Parameters and units	Data Sourse	C1.1. Permanent oligotrophic lakes, ponds and pools	C1.2. Permanent mesotrophic lakes, ponds and pools	C1.3. Permanent eutrophic lakes, ponds and pools	C1.5. Permanent inland saline and brackish lakes, ponds and pools	C1.6. Temporary lakes, ponds and pools	C2.1. Springs, spring brooks and geysers	C2.2. Permanent non-tidal, fast, turbulent water-courses
Provisioning	Materials	Biomass	Materials from plants, algae and animals for agricultural use (1212)	Animal and vegetal waste (excluding animal waste of food preparation and products); excluding animal faeces, urine and manure	t	Statistics; Ecosystem condition assessment	NR	NR	NR	NR	NR	NR	NR
			P10. Genetic materials from all biota (1213)	**Export of genetic materials for pharmaceutical use;**	**t/y;**	**Environmental Statistics; Ecosystem condition assessment (CPV code); statistics**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
				Number of species deposited in gen-banks	**Nr.**		**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
		Water	**P11 .Surface water for non-drinking purposes (1221)**	**Total gross freshwater abstraction from surface freshwater**	**mill m3/year**	**Water permits for the water body**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
			P12. Ground water for non-drinking purposes (1222)	**Total gross freshwater abstraction from fresh groundwaters**	**mill m3/year**	**Water permits for the water body**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
		Inert materials	**P13. Excavation of bottom sediments (1231)**	**Total aqmount of excavated gravel, sand, etc.**	**mill m3/year**	**Water permits for the water body**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**Y**
	Energy	Biomass-based energy sources	**P14. Plant-based resources for energy (1311)**	**Wood and plant biomass for potential use as energy source**	**m3/year**	**Permits ussued**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
			P15. Animal-based resources (1312)				NR	NR	NR	NR	NR	NR	NR
		Mechanical energy	P16. Animal-based energy (1321)				NR	NR	NR	NR	NR	NR	NR
			P16. Hydropower energy (1321)	**Amount of hydropower/ energy production**	**MWHr/year**	**Environmental Statistics; Permits ussued**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Section	Division	Group	Class (CICES Code)	Indicator measuring method	Parameters and units	Data Sourse	C1.1. Permanent oligotrophic lakes, ponds and pools	C1.2. Permanent mesotrophic lakes, ponds and pools	C1.3. Permanent eutrophic lakes, ponds and pools	C1.5. Permanent inland saline and brackish lakes, ponds and pools	C1.6. Temporary lakes, ponds and pools	C2.1. Springs, spring brooks and geysers	C2.2. Permanent non-tidal, fast, turbulent water-courses
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	**R1. Bio-remediation by micro-organisms, algae, plants, and animals (2111)**	**Direct analitical methods**	**BOD5, oxygen (%, mg O2/l)**	**Environmental Statistics; Ecosystem condition assessment; Monitoring of the chemical state**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
			R2. Filtration/sequestration/ storage/accumulation by micro-organisms, algae, plants, and animals (2112)	**Direct analitical methods**	**N-P-C; concentrations, mg/l**	**Environmental Statistics; Ecosystem condition assessment; Monitoring of the chemical state**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
	Mediation of waste, toxics and other nuisances	Mediation by ecosystems	**R3. Filtration/sequestration/ storage/accumulation by ecosystems (2121)**	**Direct analitical methods**	**Concentrations in water, sediments and organisms**	**Environmental Statistics; Ecosystem condition assessment; Monitoring of the chemical state**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
			R5. Dilution by atmosphere, freshwater and marine ecosystems (2122)	**Direct analitical methods**	**BOD5, oxygen (%, mg O2/l)**	**Water permits issued for the water body**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
			R6. Mediation of smell/noise/ visual impacts (2123)				NR	NR	NR	NR	NR	NR	NR
	Mediation of flows	Mass flows	**R7. Mass stabilisation and control of erosion rates (2211)**	**Area**	**ha**	**Water permits issued for the water body**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
			R8. Buffering and attenuation of mass flows (2212)				NR	NR	NR	NR	NR	NR	NR
		Liquid flows	**R9. Hydrological cycle and water flow maintenance (2221)**	**Water balance**	**m3/sec**	**Environmental Statistics; Ecosystem condition assessment**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
			R10. Flood protection (2222)	**Modelling**	**water levels/ flooded areas**	**Environmental Statistics; Ecosystem condition assessment**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
		Gaseous / air flows	R11. Storm protection (2231)				NR	NR	NR	NR	NR	NR	NR
			R12. Ventilation and transpiration (2232)				NR	NR	NR	NR	NR	NR	NR

Section	Division	Group	Class (CICES Code)	Indicator measuring method	Parameters and units	Data Sourse	C1.1. Permanent oligotrophic lakes, ponds and pools	C1.2. Permanent mesotrophic lakes, ponds and pools	C1.3. Permanent eutrophic lakes, ponds and pools	C1.5. Permanent inland saline and brackish lakes, ponds and pools	C1.6. Temporary lakes, ponds and pools	C2.1. Springs, spring brooks and geysers	C2.2. Permanent non-tidal, fast, turbulent water-courses
Regulation & Maintenance	Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection	R13. Pollination and seed dispersal (2311)				NR	NR	NR	NR	NR	NR	NR
			R14. Maintaining nursery populations and habitats (2312)	**Biodiversity WFD Protected Areas, Nursery areas**	**area, ha**	**Y**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
		Pest and desease control	R15. Pest control (2321)				NR	NR	NR	NR	NR	NR	NR
			R16. Disease control (2322)				NR	NR	NR	NR	NR	NR	NR
		Soil formation and composition	R17. Weathering processes (2331)				NR	NR	NR	NR	NR	NR	NR
			R18. Decomposition and fixing processes (2332)				NR	NR	NR	NR	NR	NR	NR
	Maintenance of physical, chemical, biological conditions	Water conditions	**R19. Ecological state/ condition of freshwaters (2341)**	**Direct analitical methods**	**EQR**	**Environmental Statistics; Ecosystem condition assessment**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
			R19. Chemical state/ condition of freshwaters (2341)	**Direct analitical methods**	**concentrations**	**Environmental Statistics; Ecosystem condition assessment; Monitoring of the chemical state**							
			R20. Chemical condition of salt waters (2342)				NR	NR	NR	NR	NR	NR	NR
		Atmospheric composition and climate regulation	R21. Global climate regulation by reduction of greenhouse gas concentrations (2351)				NR	NR	NR	NR	NR	NR	NR
			R22. Micro- and regional climate regulation (2352)				NR	NR	NR	NR	NR	NR	NR

Section	Division	Group	Class (CICES Code)	Indicator measuring method	Parameters and units	Data Sourse	C1.1. Permanent oligotrophic lakes, ponds and pools	C1.2. Permanent mesotrophic lakes, ponds and pools	C1.3. Permanent eutrophic lakes, ponds and pools	C1.5. Permanent inland saline and brackish lakes, ponds and pools	C1.6. Temporary lakes, ponds and pools	C2.1. Springs, spring brooks and geysers	C2.2. Permanent non-tidal, fast, turbulent water-courses
Cultural	Physical and intellectual interactions with biota, ecosystems, and land-/seascapes [environmental settings]	Physical & experiential interactions	**C1. Experiential use of plants, animals and land-/ seascapes in different environmental settings (3111)**	**Visitors**	**number**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
			C2. Physical use of land-/seascapes in different environmental settings (3112)	**Visitors**	**number**	**Y**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
		Intellectual and representative interactions	**C3. Scientific (3121)**	**Conservation significance**	**Number of sites in protected areas (Ramsar wetlands, Natura2000 sites, reserves**	**Environmental Statistics**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
			C4. Educational (3122)	**Conservation significance**	**Number of sites in protected areas (Ramsar wetlands, Natura2000 sites, reserves)**	**Environmental Statistics**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
			C5. Heritage, cultural (3123)	**Cultural value**	**Number of visitors**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
	Physical and intellectual interactions with biota, ecosystems, and land-/seascapes [environmental settings]	Intellectual and representative interactions	**C6. Entertainment (3124)**	**Fishing/angling**	**Number of visitors/ anglers**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
			C7. Aesthetic (3125)	**Aesthetic landscapes**	**Number of nature/water landscape photos uploaded on web portals**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
	Spiritual, symbolic and other interactions with biota, ecosystems, and land-/ seascapes [environmental settings]	Spiritual and/or emblematic	**C8. Symbolic (3211)**	**Symbolic species**	**Number of symbolic species**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
			C9. Sacred and/or religious (3212)	**Number of visitors**	**Number of sites**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
		Other cultural outputs	**C10. Existence (3221)**	**Direct analitical methods**	**Number of visitors**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
			C11. Bequest (3222)	Direct analitical methods	Number of visitors	Y	Y	Y	Y	Y	Y	Y	Y

NR indicatora is not relevant to the freshwater ecosystems
Y data available
NA no data available
accepted indicators for ESS assessment

Section	Division	Group	Class (CICES Code)	Indicator measuring method	Parameters and units	Data Sourse	C2.3. Permanent non-tidal, smooth-flowing water-courses	C2.5. Temporary running waters	X01. Estuaries	X03. Brackish coastal lagoons	J5.2. Highly artificial saline and brackish running waters	J5.3. Highly artificial non-saline standing waters	J5.4. Highly artificial non-saline running waters
Provisioning	Nutrition	Biomass	P1. Cultivated crops (1111)	Harvest as % of country average depending on ecosystem state		Statistics; Ecosystem condition assessment	NR	NR	NR	NR	NR	NR	NR
			P2. Reared animals and their outputs (1112)	Yield as % of country average depending on ecosystem state		Statistics; Ecosystem condition assessment	NR	NR	NR	NR	NR	NR	NR
			P3. Wild plants, algae and their outputs (1113)	% of primary biomass production for food	t/ha	Statistics; Ecosystem condition assessment	NR	NR	NR	NR	NR	NR	NR
			P4. Wild animals and their outputs (1114)	**Heads of animals reared for hunting/ Fish stock**	**t/year; condition unit**	**Environmental Statistics; Ecosystem condition assessment**	**Y**	**Y**	**Y**	**Y**	**NR**	**NR**	**NR**
			P5. Plants and algae from in-situ aquaculture (1115)	Annual production	t/ha	Statistics; Ecosystem condition assessment	NA	NA	NA	NA	NR	NR	NR
			P6. Animals/fish from in-situ aquaculture (1116)	**Fisheries, mussel farms, frogs, etc.**	**t/year; condition unit**	**Environmental Statistics; Ecosystem condition assessment**	**Y**	**NA**	**Y**	**Y**	**NR**	**NR**	**NR**
		Water	**P7. Surface water for drinking (1121)**	**Drinking water consumption by the population**	**l/day per capita**	**Water permits for the water body**	**Y**	**NA**	**NA**	**NA**	**NR**	**NR**	**NR**
			P8. Ground water for drinking (1122)	**Consumption of groundwater**	**l/day per capita**	**Water permits for wells, groundwater permits, concessions**	**Y**	**NA**	**NA**	**NA**	**NR**	**NR**	**NR**
	Materials	Biomass	P9. Fibres and other materials from plants, algae and animals for direct use or processing (1211)	Harvest/Yield as % of country average depending on ecosystem state % of primary biomass production for food Raw material inputs per capita Raw material consumption per capita	T/ha T per capita	Statistics; Ecosystem condition assessment	NR	NR	NR	NR	NR	NR	NR

Section	Division	Group	Class (CICES Code)	Indicator measuring method	Parameters and units	Data Sourse	C2.3. Permanent non-tidal, smooth-flowing water-courses	C2.5. Temporary running waters	X01. Estuaries	X03. Brackish coastal lagoons	J5.2. Highly artificial saline and brackish running waters	J5.3. Highly artificial non-saline standing waters	J5.4. Highly artificial non-saline running waters
Provisioning	Materials	Biomass	Materials from plants, algae and animals for agricultural use (1212)	Animal and vegetal waste (excluding animal waste of food preparation and products); excluding animal faeces, urine and manure	t	Statistics; Ecosystem condition assessment	NR	NR	NR	NR	NR	NR	NR
			P10. Genetic materials from all biota (1213)	**Export of genetic materials for pharmaceutical use;**	**t/y;**	**Environmental Statistics; Ecosystem condition assessment (CPV code); statistics**	**NA**	**NA**	**NA**	**NA**	**NR**	**NR**	**NR**
				Number of species deposited in gen-banks	**Nr.**		**NA**	**NA**	**NA**	**NA**	**NR**	**NR**	**NR**
		Water	**P11 .Surface water for non-drinking purposes (1221)**	**Total gross freshwater abstraction from surface freshwater**	**mill m3/year**	**Water permits for the water body**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
			P12. Ground water for non-drinking purposes (1222)	**Total gross freshwater abstraction from fresh groundwaters**	**mill m3/year**	**Water permits for the water body**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
		Inert materials	**P13. Excavation of bottom sediments (1231)**	**Total aqmount of excavated gravel, sand, etc.**	**mill m3/year**	**Water permits for the water body**	**Y**	**Y**	**NR**	**NR**	**NR**	**NR**	**NR**
	Energy	Biomass-based energy sources	**P14. Plant-based resources for energy (1311)**	**Wood and plant biomass for potential use as energy source**	**m3/year**	**Permits ussued**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
			P15. Animal-based resources (1312)				NR	NR	NR	NR	NR	NR	NR
		Mechanical energy	P16. Animal-based energy (1321)				NR	NR	NR	NR	NR	NR	NR
			P16. Hydropower energy (1321)	**Amount of hydropower/ energy production**	**MWHr/year**	**Environmental Statistics; Permits ussued**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Section	Division	Group	Class (CICES Code)	Indicator measuring method	Parameters and units	Data Sourse	C2.3. Permanent non-tidal, smooth-flowing water-courses	C2.5. Temporary running waters	X01. Estuaries	X03. Brackish coastal lagoons	J5.2. Highly artificial saline and brackish running waters	J5.3. Highly artificial non-saline standing waters	J5.4. Highly artificial non-saline running waters
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	**R1. Bio-remediation by micro-organisms, algae, plants, and animals (2111)**	**Direct analitical methods**	**BOD5, oxygen (%, mg O2/l)**	**Environmental Statistics; Ecosystem condition assessment; Monitoring of the chemical state**	**Y**	**Y**	**Y**	**Y**	**NR**	**NR**	**NR**
			R2. Filtration/sequestration/ storage/accumulation by micro-organisms, algae, plants, and animals (2112)	**Direct analitical methods**	**N-P-C; concentrations, mg/l**	**Environmental Statistics; Ecosystem condition assessment; Monitoring of the chemical state**	**NA**	**NA**	**NA**	**NA**	**NR**	**NR**	**NR**
	Mediation of waste, toxics and other nuisances	Mediation by ecosystems	**R3. Filtration/sequestration/ storage/accumulation by ecosystems (2121)**	**Direct analitical methods**	**Concentrations in water, sediments and organisms**	**Environmental Statistics; Ecosystem condition assessment; Monitoring of the chemical state**	**NA**	**NA**	**NA**	**NA**	**NR**	**NR**	**NR**
			R5. Dilution by atmosphere, freshwater and marine ecosystems (2122)	**Direct analitical methods**	**BOD5, oxygen (%, mg O2/l)**	**Water permits issued for the water body**	**Y**	**Y**	**Y**	**Y**	**NR**	**NR**	**NR**
			R6. Mediation of smell/noise/ visual impacts (2123)				NR	NR	NR	NR	NR	NR	NR
	Mediation of flows	Mass flows	**R7. Mass stabilisation and control of erosion rates (2211)**	**Area**	**ha**	**Water permits issued for the water body**	**NA**	**NA**	**NA**	**NA**	**NR**	**NR**	**NR**
			R8. Buffering and attenuation of mass flows (2212)				NR	NR	NR	NR	NR	NR	NR
		Liquid flows	**R9. Hydrological cycle and water flow maintenance (2221)**	**Water balance**	**m3/sec**	**Environmental Statistics; Ecosystem condition assessment**	**Y**	**Y**	**Y**	**Y**	**NR**	**NR**	**NR**
			R10. Flood protection (2222)	**Modelling**	**water levels/ flooded areas**	**Environmental Statistics; Ecosystem condition assessment**	**Y**	**Y**	**Y**	**Y**	**NR**	**NR**	**NR**
		Gaseous / air flows	R11. Storm protection (2231)				NR	NR	NR	NR	NR	NR	NR
			R12. Ventilation and transpiration (2232)				NR	NR	NR	NR	NR	NR	NR

Section	Division	Group	Class (CICES Code)	Indicator measuring method	Parameters and units	Data Sourse	C2.3. Permanent non-tidal, smooth-flowing water-courses	C2.5. Temporary running waters	X01. Estuaries	X03. Brackish coastal lagoons	J5.2. Highly artificial saline and brackish running waters	J5.3. Highly artificial non-saline standing waters	J5.4. Highly artificial non-saline running waters
Regulation & Maintenance	Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection	R13. Pollination and seed dispersal (2311)				NR	NR	NR	NR	NR	NR	NR
			R14. Maintaining nursery populations and habitats (2312)	**Biodiversity WFD Protected Areas, Nursery areas**	**area, ha**	**Y**	**NA**	**NA**	**NA**	**NA**	**NR**	**NR**	**NR**
		Pest and desease control	R15. Pest control (2321)				NR	NR	NR	NR	NR	NR	NR
			R16. Disease control (2322)				NR	NR	NR	NR	NR	NR	NR
		Soil formation and composition	R17. Weathering processes (2331)				NR	NR	NR	NR	NR	NR	NR
			R18. Decomposition and fixing processes (2332)				NR	NR	NR	NR	NR	NR	NR
	Maintenance of physical, chemical, biological conditions	Water conditions	**R19. Ecological state/ condition of freshwaters (2341)**	**Direct analitical methods**	**EQR**	**Environmental Statistics; Ecosystem condition assessment**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
			R19. Chemical state/ condition of freshwaters (2341)	**Direct analitical methods**	**concentrations**	**Environmental Statistics; Ecosystem condition assessment; Monitoring of the chemical state**							
			R20. Chemical condition of salt waters (2342)				NR	NR	NR	NR	NR	NR	NR
		Atmospheric composition and climate regulation	R21. Global climate regulation by reduction of greenhouse gas concentrations (2351)				NR	NR	NR	NR	NR	NR	NR
			R22. Micro- and regional climate regulation (2352)				NR	NR	NR	NR	NR	NR	NR

Section	Division	Group	Class (CICES Code)	Indicator measuring method	Parameters and units	Data Sourse	C2.3. Permanent non-tidal, smooth-flowing water-courses	C2.5. Temporary running waters	X01. Estuaries	X03. Brackish coastal lagoons	J5.2. Highly artificial saline and brackish running waters	J5.3. Highly artificial non-saline standing waters	J5.4. Highly artificial non-saline running waters
Cultural	Physical and intellectual interactions with biota, ecosystems, and land-/seascapes [environmental settings]	Physical & experiential interactions	C1. Experiential use of plants, animals and land-/ seascapes in different environmental settings (3111)	Visitors	number	NA	NA	NA	NA	NA	NR	NR	NR
			C2. Physical use of land-/seascapes in different environmental settings (3112)	Visitors	number	Y	NA	NA	NA	NA	NR	NR	NR
		Intellectual and representative interactions	C3. Scientific (3121)	Conservation significance	Number of sites in protected areas (Ramsar wetlands, Natura2000 sites, reserves	Environmental Statistics	Y	Y	Y	Y	Y	Y	Y
			C4. Educational (3122)	Conservation significance	Number of sites in protected areas (Ramsar wetlands, Natura2000 sites, reserves)	Environmental Statistics	Y	Y	Y	Y	Y	Y	Y
			C5. Heritage, cultural (3123)	Cultural value	Number of visitors	Y	Y	Y	Y	Y	Y	Y	Y
	Physical and intellectual interactions with biota, ecosystems, and land-/seascapes [environmental settings]	Intellectual and representative interactions	C6. Entertainment (3124)	Fishing/angling	Number of visitors/ anglers	Y	Y	Y	Y	Y	Y	Y	Y
			C7. Aesthetic (3125)	Aesthetic landscapes	Number of nature/water landscape photos uploaded on web portals	Y	Y	Y	Y	Y	Y	Y	Y
	Spiritual, symbolic and other interactions with biota, ecosystems, and land-/ seascapes [environmental settings]	Spiritual and/or emblematic	C8. Symbolic (3211)	Symbolic species	Number of symbolic species	Y	Y	Y	Y	Y	Y	Y	Y
			C9. Sacred and/or religious (3212)	Number of visitors	Number of sites	Y	Y	Y	Y	Y	Y	Y	Y
		Other cultural outputs	C10. Existence (3221)	Direct analitical methods	Number of visitors	Y	Y	Y	Y	Y	Y	Y	Y
			C11. Bequest (3222)	Direct analitical methods	Number of visitors	Y	Y	Y	Y	Y	Y	Y	Y

NR indicatora is not relevant to the freshwater ecosystems
Y data available
NA no data available
accepted indicators for ESS assessment

ANNEX 8 - B8

References

Burkhard, B., Kandziora, M., Hou, Y., Müller, F. (2014) Ecosystem Service Potentials, Flows and Demands – Concepts for Spatial Localisation, Indication and Quantification. LANDSCAPE ONLINE 34:1-32 (2014), DOI 10.3097/LO.201434.

Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks

MAES 2013 Mapping and Assessment of Ecosystems and their Services. An analytical framework for ecosystem assessments under action 5 of the EU biodiversity strategy to 2020.Technical Report 2013 – 067, European Commission.

Ordinance N-4 on surface waters characterization, issued by the Minister of the Environment & Water (State Gazette No 22/05.03.2013, amended in SG No 79/23.09.2014)

The Water Framework Directive (WFD 2000/60/EC) of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy)

ANNEX 9 - B8

Database templates and nomenclature tables

The databases and related tables and vector layers described in the methodological part of the document, as well as the nomenclature tables for ecosystem types and indicators for condition and ecosystem services are provided in a digital format to this Methodology.

The structure and content of the data under Appendix 9 is as follows:

1. Directory: 9.00_EcosystemDatabase_Schema

Contains a template of the database to this methodology in several different formats:
- Ecosystem_DB_v07.diagram: database structure for review in ArcGIS Diagrammer - free software for creating, editing and analyzing geodatabase schemas
- Ecosystem_DB_v07.mdb: database structure in MDB format;
- Ecosystem_DB_v07. XML: database structure in XML format;
- Ecosystem_DB_v07. jpg: preview of the database schema in JPG format.

2. Directory: 9.01_Schema_Report_ES_Database

It contains a descriptive geodatabase document including the specifications of all the tables and vector layers, as well as a description of all the attribute fields in them:
- 9.01_0_Schema_Report_ES_Database.htm: document describing the structure of the database.

3. Directory: 9.02_NOMENCLATURES_XLS

Contains nomenclature tables for ecosystem types and for the indicators for condition and ecosystem services:
- N_EcosystemType.xls: table in MS Excel format containing all ecosystem types at different hierarchical levels;
- N_EcosystemCondition.xls: MS Excel table containing nomenclatures for ecosystem condition indicators up to level 3;
- N_EcosystemConditionIndicator_Parameter.xls: MS Excel table containing information on how to create a table for ecosystem condition parameters for each specific ecosystem type;
- N_EcosystemService.xls: MS Excel table containing ecosystem services nomenclatures up to level 4
- N_EcosystemService_Indicator.xls: an MS Excel table containing information on how to create a table for ecosystem service indicators for each specific ecosystem type;
- Instruction_Nomenclature_Tables_ES_Condition_Services.docx: document in MS Word format containing a description of the sequence and specifics for filling in all the nomenclature tables of the Methodology as well as the tables in the database for each specific ecosystem type.

4. Directory: 9.03_Data_Maps

Contains the EEA (European Environment Agency) reference grid for Bulgaria at 50 km grid.

The data and documents in Annex 9 are available on:

http://www.metecosmap-sofia.org/methodological-framework/